MACHINERY

DESIGN — CONSTRUCTION — OPERATION

Volume 35 OCTOBER, 1928 Number 2

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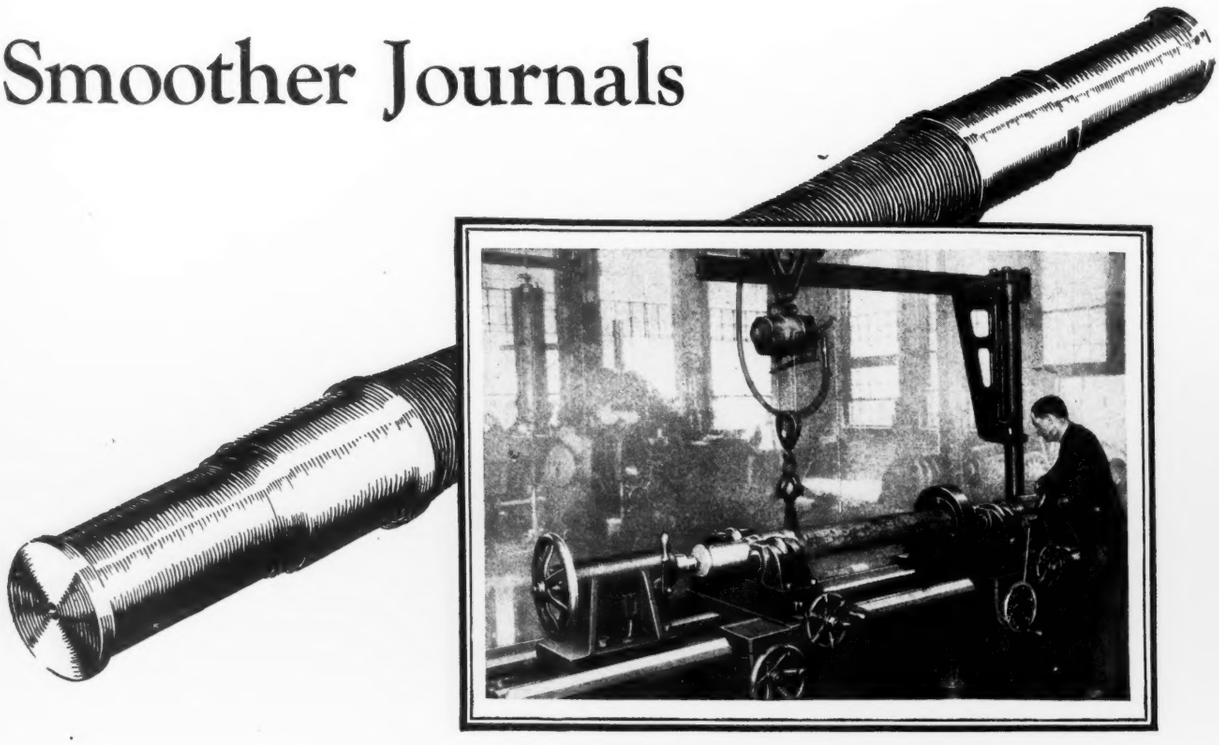

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MACHINERY

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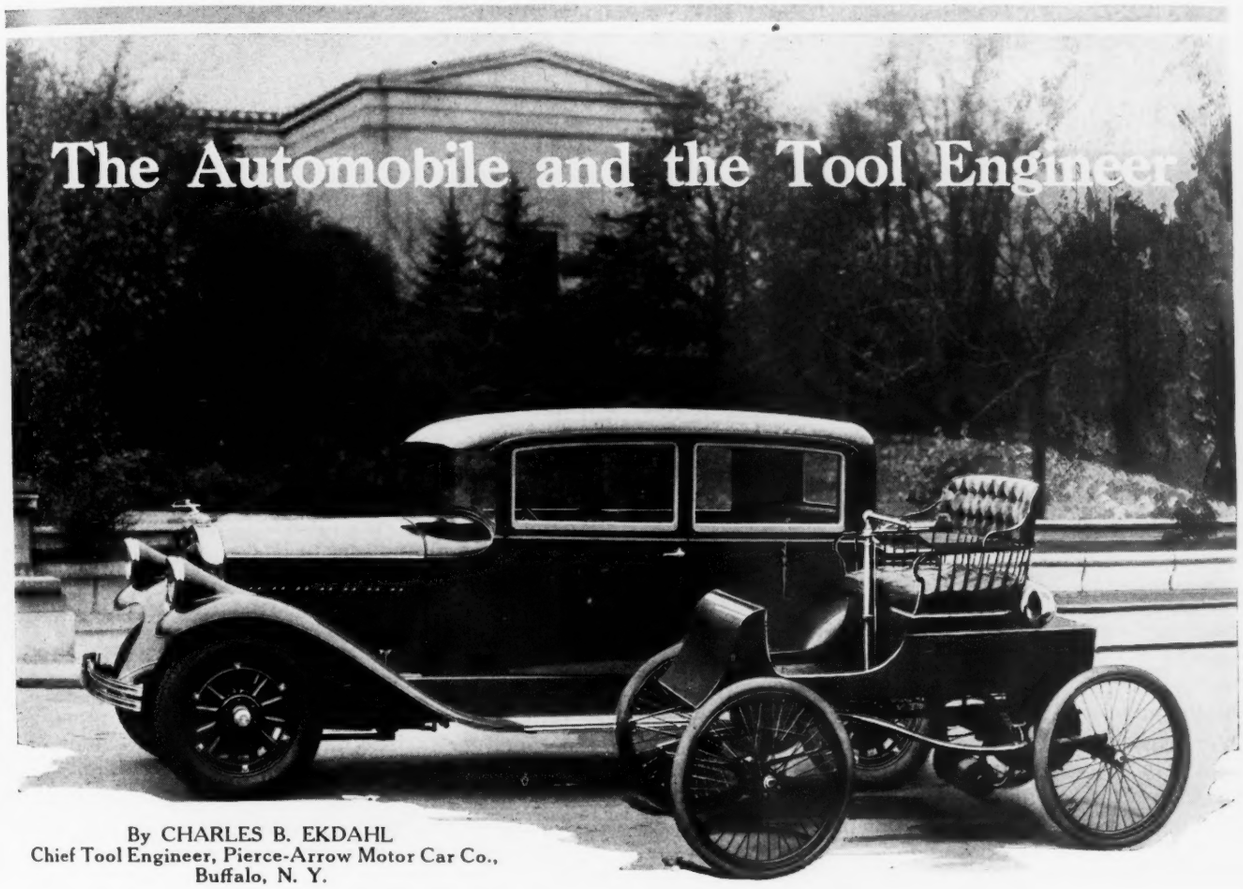
The Automobile and the Tool Engineer



By CHARLES B. EKDAHL
Chief Tool Engineer, Pierce-Arrow Motor Car Co.,
Buffalo, N. Y.

IT is safe to say, without running the risk of being accused of making an exaggerated statement, that in no other industrial field have such great and rapid changes been made in the product manufactured during the last twenty-five years, as in the automotive industry. Compare the first car made by the company with which the writer is connected with the present-day model, as shown in the heading illustration. The two do not appear to belong to the same species, yet there is only a span of twenty-seven years between them. Every middle-aged person of today remembers when he had never seen an automobile.

For this tremendous advance, the automobile designer is justly entitled to credit, but we must not forget that the progress in this field has been made possible only through cooperation between three main contributing factors—the automobile designer, the tool engineer, and the machine tool builder.

The great growth in automotive production during the last twenty years has given rise to problems in automotive design that were not even dreamed of in the early days of the industry. In those days, no thought was given by the automobile designing engineer to the manufacturing problems involved in producing the car which he deftly laid out on the drawing-board. His chief concern was to design a car that would run; and with the state of the art at that time, it was a real achievement to produce a car that could be taken out on a fine morning and that would return home the same evening without having forced its owner to lie on his back beneath the car, one or more times during the day, attempting to put a balking engine back into running condition.

The problem of designing a car that is almost ideal from the standpoint of both performance and appearance is no longer unsolved, but after this problem has been met and disposed of, there is quite another problem facing the manufacturer; that is, to obtain a design that, without sacrificing performance and appearance, will represent an ideal manufacturing proposition. By an "ideal manufacturing proposition" I mean a car that can be built economically.

The tremendously important work of suggesting modifications of design that will permit of more economical production has called for an entirely new class of engineers known as production and tool engineers. It is the tool engineer's job to take the ideal of the automotive designing engineer and convert it into a practicability. In general, it is only inside automobile manufacturing plants that the work of the tool engineer is thoroughly understood and the extent of his activities appreciated. For that reason, this article will briefly indicate the

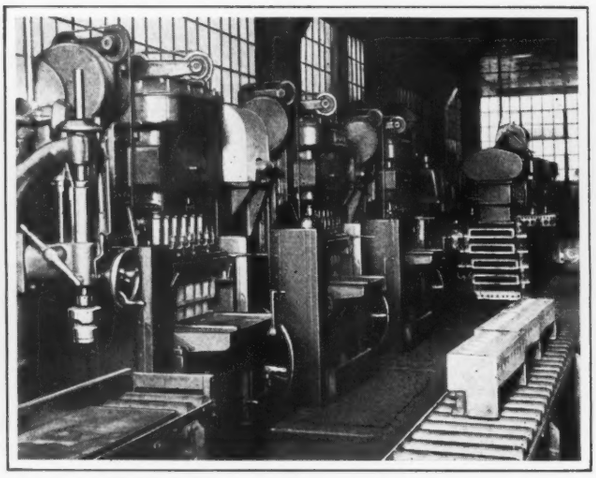


Fig. 1. Six-spindle Boring Machine Line-up for Cylinder Blocks

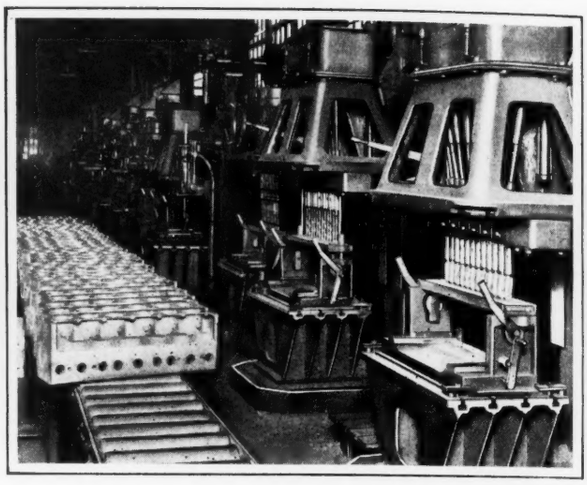


Fig. 2. First Section of Multiple-spindle Drilling Machines for Cylinder Blocks

contribution of the tool engineer to the development of the automotive industry, by presenting a few examples of the special equipment that he must provide for the successful and economical manufacture of a car.

How Skill Has Been Transferred from Men to Machines

Much has been said about the lack of mechanical skill among present-day machine shop workers. It should be understood, however, that all-around skill, such as was possessed by the machinist of twenty-five years ago, is no longer required for the work performed by the majority of the men engaged in present-day mass production. As a matter of fact, the problem of training all these men to become skilled mechanics would present almost insurmountable difficulties; nor is it necessary to try to do this.

Instead of centering our hopes and efforts on the training of additional forces of skilled mechanics, we have taken matters as we found them and segregated the more intelligent and skilled workmen from those who were better fitted to be mainly machine operators. The brains and skill of the high-class mechanics are used for the purpose of furnishing the machine operators with certain equipment which can be used by them as a substitute for skill.

From this class of skilled mechanics has been developed the toolmaker, and from the toolmaker the tool designer—the man who excels in his ability to invent and construct tools and special devices for manufacturing purposes. His work, like that of the automotive designing engineer, is done at the drawing-board, and the best results in economical production are produced when these two types of men are able to thoroughly cooperate. While the automotive engineer's job consists in producing a car that will perform properly, the tool designer's or tool engineer's job consists in devising the ways and means to produce each part of the automobile, and not only produce them, but produce them quickly, accurately, and economically.

Duties of the Tool Engineer

From being merely a designer of tools and methods, the work of the tool engineer has developed until he also designs and supervises the building of special machinery and shop equipment of all kinds, devises means for shop transportation, lays out factories, and plans the rotation of work and the sequence of operations. Hence, he should be more properly called a production engineer.

Fig. 3. Second Section of Multiple-spindle Drilling Machines for Cylinder Blocks

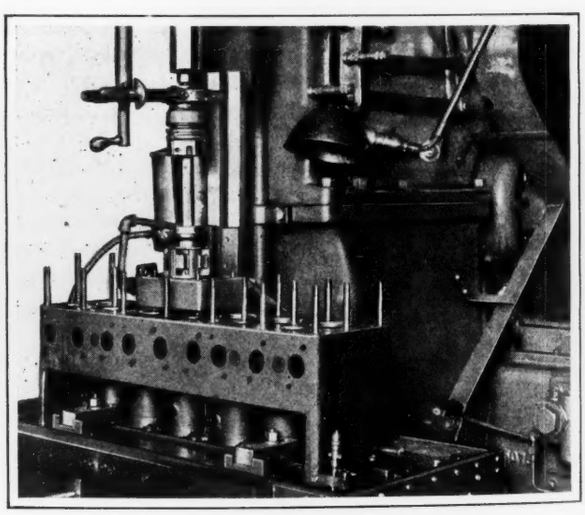


Fig. 4. Close-up View of Cylinder Block in a Honing Machine, Showing Block being Honed

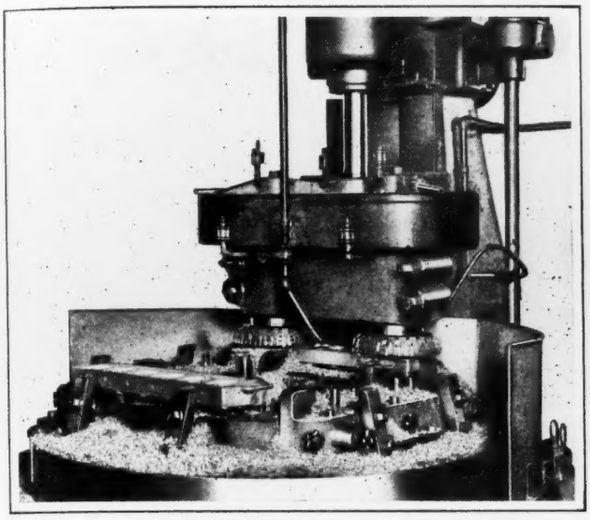


Fig. 5. Rotary Milling Machine Used in Machining Cylinder Heads

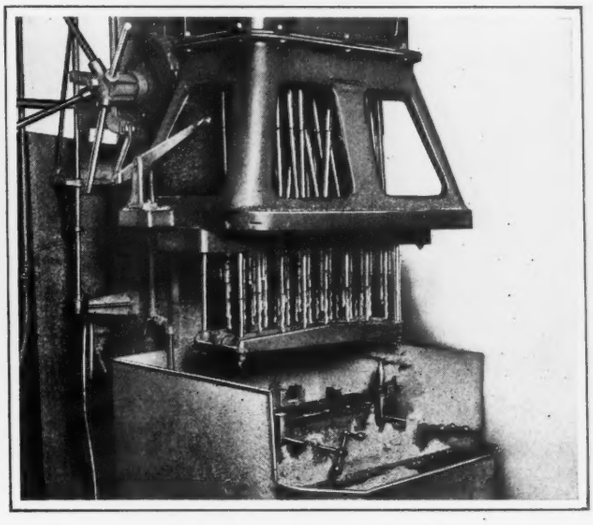


Fig. 6. Multiple-spindle Drill Equipped for Drilling Cylinder Heads

To produce a satisfactory new design for an automobile takes time. After several months of designing and secret experimental work, careful tests, and repeated changes, the automotive engineer produces what he considers to be the "ultimate car." Then the management announces: "O. K. for production." It is at this moment that the work of the production and the purchasing divisions, the machine tool builders, and the tool manufacturers begins. The sources of supply have to be established; the sequence of operations determined; small tools, machine tools, and special machines must be purchased; the production lines must be laid out; conveying systems provided; and the available floor space used in the most economical manner.

Perhaps the ultimate success depends most of all upon the proper design of special tools. In designing new special tools, the tool engineer clings to the principles that he has found successful in the past, embodying new ideas only to the extent that he is certain that they will prove successful, because no tool engineer can afford to conduct experiments in the production line. He must, however, constantly adjust himself to the advancement made in machine tool building. He must be able to meet the new problems introduced by the uses of new materials more difficult to machine, and he must be able to gradually introduce entirely new methods in such a manner that the steady flow of production will not be interfered with.

Tools and Machines for Cylinder Block

Permanent Tools		Perishable Tools		Machinery	
Milling Fixtures	8	Gages	22	Continuous Rotary Mill	1
Drill Jigs	10	Milling Cutters	4	Multi-drills, 12-spindle	4
Tapping Fixtures	4	Drills	154	Multi-drills, 39-spindle	3
Cylinder Boring-bars	18	Reamers	90	Multi-drills, 21-spindle	1
Spindle Heads	3	Taps	106	Multi-drills, 22-spindle	2
Cluster Plates	5	Spot-facers	24	Cylinder Borer, 6-spindle	3
Honing Fixtures	2	Special Wrenches	7	Drill Press, Single-spindle	4
Grinding Fixtures	5	Cutter Blades	148	Drill Press, Radial	1
Miscellaneous Tools	41			Facing Machine	1
Total	96	Total	555	Cylinder Grinders	5
				Honing Machines	2
				Power Press	1
				Valve Grinder, 12-spindle	1
				Total	29

Layout Drawings 7
Tool Drawings 110

Machinery

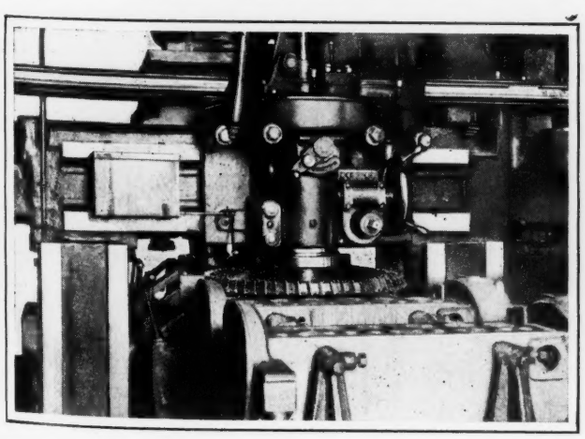


Fig. 7. Rail Type Milling Machine Milling the Top of the Crankcase with a 32-inch Cutter

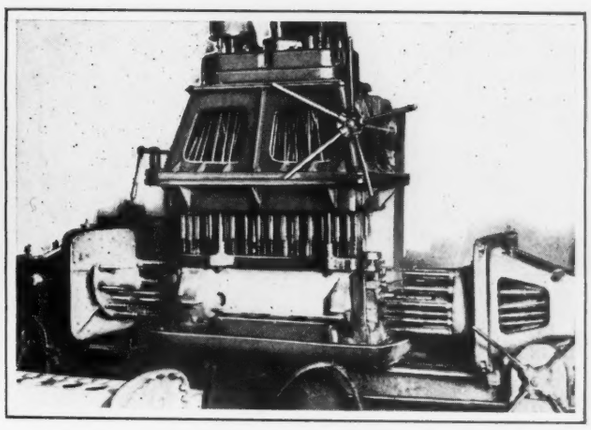


Fig. 8. Drilling the Holes in the Top and Both Ends of a Crankcase Simultaneously

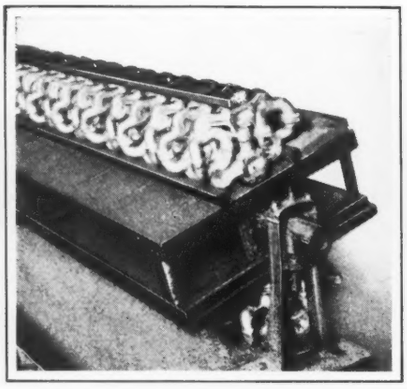


Fig. 9. Polishing Gas Passage in Inlet Manifolds

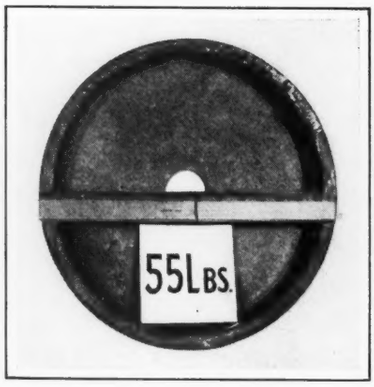


Fig. 10. A Brake-drum Forging before Machining

Fig. 11. Same Brake-drum after Machining

Equipment Required for Production

Few men outside the automobile plants realize the great number of different machines, tools, jigs, fixtures, and gages required in production. As an example, the accompanying table shows that, for the production of a cylinder block alone, 96 permanent jigs, fixtures, and other tools are required; 555 perishable tools are used; while 29 different machine tools are employed. To produce the special tools and fixtures, 7 separate lay-out drawings were required and 110 tool drawings; nor are the jigs and fixtures of very simple design. An idea of the complicated drawings required may be had from a study of the author's former articles, "Machining Pierce-Arrow Cylinders," in the August, 1925, number of MACHINERY, page 968, and "Tools and Fixtures in the Pierce-Arrow Plant," September, 1925, MACHINERY, page 46, where a few of these fixtures were illustrated and described.

The tool engineer is also expected to estimate the total cost of the tool equipment for an automobile before the equipment is built. This is by no means the easiest of his tasks. Furthermore, a slight change in the design of a part of the automobile may require almost the total redesigning of dozens of tools and fixtures, and sometimes an entirely different line-up for production.

The many special machines used are built by a comparatively small number of machine tool builders, to whose credit it must be said that they have developed remarkably efficient equipment at comparatively small profit to themselves and largely to the advantage of the automobile manufacturer and to the general public. The automobile buyer has benefitted by constantly decreasing prices of cars.

Drawings must be clear and explicit. The jigs, fixtures, and special tools must be drawn in such a manner as to be self-explanatory to the toolmaker, because the tool designer is generally so far removed from the tool-room that it is inconvenient to have to ask questions; nor is the foreman expected to study the drawings and answer the questions of his men. Furthermore, much of this work, of necessity, is sent to outside toolmaking concerns. While all automobile plants maintain an extensive tool-room, not only for the building of new tools, but particularly for the purpose of maintaining existing tools, it would be impossible to keep in readiness as large a tool-room as would be required for handling suddenly, and at intervals, the large volume of tool work needed when an entirely new model is tooled up for production.

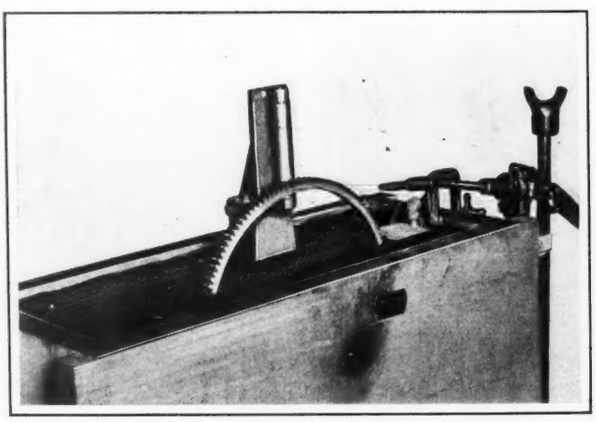


Fig. 12. Hardening Machine for Flywheel Starter Ring Gears

Examples of Special Equipment

The accompanying illustrations show a number of tools, jigs, and fixtures that have been developed for the economical production of automobiles. They are given merely as an indication of the vast amount of special equipment employed in automobile factories. The brief captions in connection with each picture are, in most cases, sufficient to explain their purpose. Some additional information may be required in regard to a few of these illustrations.

In the boring machine line-up, Fig. 1, six-spindle Foote-Burt machines are used. The rough-boring time for the entire cylinder block is 6.15 minutes. The boring time for the second cut is 5 minutes, and for the finishing cut, 5.50 minutes, three cuts being taken in all.

Fig. 4 shows a close-up view of a Barnes Drill Co.'s cylinder honing machine, showing a block in process of being honed. This machine is provided with Hutto equipment. The honing of the cylinders has proved to give greater accuracy at lower cost; chatter marks and mottled effects are avoided; and roundness and smoothness of the cylinder wall may be obtained within limits of 0.0005 inch. The time required for the honing operation is 12 to 15 minutes per cylinder. The life of the stones is approximately equivalent to 250 cylinder blocks, or 1500 holes. The machine spindle makes 300 revolutions per minute with

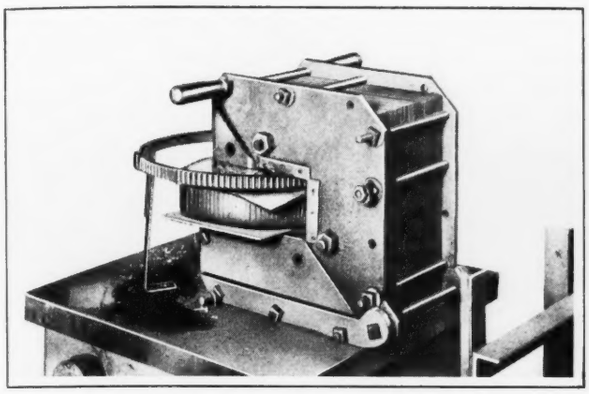


Fig. 13. The Heater Shown in Fig. 15 Closed, Gear being Heated

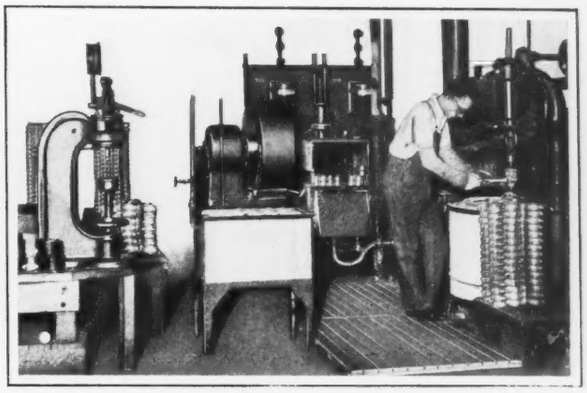


Fig. 14. Equipment for Babbitting Crank End of Aluminum Connecting-rod

75 vertical strokes per minute, the stroke being controlled hydraulically.

An Ingersoll rail type milling machine is shown in Fig. 7 milling the top of a crankcase with a cutter 32 inches in diameter. A few years ago such large cutters of this design were considered impracticable. In this instance, I believe that the automotive tool engineer may take the credit for having urged the adoption of cutters of this size.

The drilling of the holes in the top and both ends of the crankcase, as shown in Fig. 8, is performed on a Baush standard type of machine with special cluster plates; on this job, fifty-five spindles are at work at one time.

In Fig. 9 is shown a type of tumbling equipment. This apparatus is used for polishing the gas passage in inlet manifolds; sixty-four manifolds are carried at one time, and the tumbler is operated for eight hours to complete the polishing of the passages.

Figs. 10 and 11 show a good example of why modern machine tools must be "hogs" on metal. This brake-drum forging is made from an 0.40 to 0.50 per cent carbon steel. It weighs 55 pounds in the rough and only 18 pounds when finished, more than two-thirds of the original metal having been removed.

Equipment for Hardening and Shrinking-on Flywheel Starter Ring Gears

In Fig. 12 is shown a machine employed for the hardening process on flywheel starter ring gears. This machine is driven by a variable-speed motor through a chain which transmits motion to a Geneva gear, which, in turn, drives the ring gear while it is being alternately heated and submerged in the cooling oil bath.

As will be noted, a gas flame is impinged upon the gear teeth. The motion is so arranged that the gas flame will heat the gear tooth for about one-fourth its length during about 2 1/4 seconds. Immediately after being heated, the gear automatically moves into the cooling bath, which hardens the heated part of the tooth to a depth of about 1/8 inch. The total hardening time is 4 3/4 minutes per gear for a gear with 126 teeth and 8/10 stub-tooth pitch. The material from which the gear is made is S. A. E. steel No. 1045 (0.40 to 0.50 carbon).

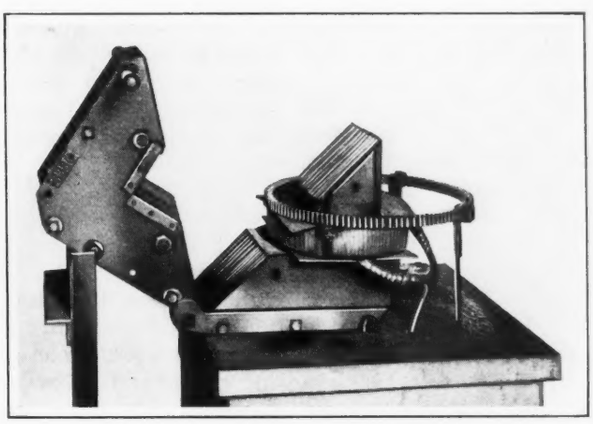


Fig. 15. An Electric Heater for the Flywheel Starter Ring Gears

After being hardened, the gear is placed in the electric heater shown open in Fig. 15 and closed in Fig. 13, where the gear is heated to expand it for shrinking it on the flywheel. The gear is bored 0.018 inch smaller than the diameter of the flywheel. The electric heating device is kept closed, as shown in Fig. 13, for about half a minute, during which time the gear is heated to from 400 to 450 degrees F.; this expands it about 0.030 inch. In the heating device, the ring gear itself acts as the secondary winding. The coil in the primary winding carries 350 volts direct current, 35 amperes. The current cost for heating each ring gear is about one cent.

Fig. 16 shows the gear after having been removed from the electric heating device and placed over the flywheel on a plate-holding fixture, where it is cooled off by a stream of water which causes the ring to contract.

Babbitting Connecting-rods

Fig. 14 shows a general view of the equipment used for babbitting the crank end of the aluminum connecting-rod. The equipment is automatically controlled by electric means. Fig. 17 shows a close-up view of the rod, placed over a pin in the babbitting machine and located by an adapter. A special ladle, as shown, is used, which holds an exact predetermined amount of babbitt.

The complete procedure in babbitting connecting-rods is as follows: First the connecting-rod is washed in hot water and dried in an oven. It is then heated in a tin bath to from 750 to 850 degrees F. Next it is wire-brushed in a small drill press, which is rotated at 120 revolu-

tions per minute. The brush is lowered momentarily into the tin bath to cover it with tin. The rod is also dipped in the bath, and held against the revolving brush. The brush and the rod are alternately dipped into the tin bath until the rod is properly tinned. Proper tinning is determined by a bright metallic luster on the surface of the rod.

The rod is now placed in a second tin bath for not more than thirty seconds, to remove all oxide and to keep the tin in a molten state for babbitting. The temperature of this tin bath is from 500 to 600 degrees F. Next, the rod is placed in the preheated centrifugal babbitting machine, the fixture holding the rod revolving at 600 revolutions per minute. With a ladle holding the proper amount of babbitt for one rod, as mentioned, the babbitt

Fig. 16. The Ring Gear is Placed over the Flywheel on a Plate Fixture and Cooled off by a Stream of Water which Causes the Ring to Contract

is poured on the tinned surface. The rod is left in the machine and the machine remains in motion until the next rod is ready for babbitting. This allows sufficient time for the babbitt in the rod to solidify. The rod is then removed and the next one put in place.

The molten babbitt is held at a temperature of from 800 to 850 degrees F. Its composition is as follows: 89 per cent tin; 7.3 per cent antimony; 3.7 per cent copper. The connecting-rod is made from an aluminum drop-forging, heat-treated, and is of the No. 25-S composition of the United States Aluminum Co. The total time required for babbitting the connecting-rod is 1 1/2 minutes, of which time the rod is in the babbitting machine 45 seconds.

The preceding examples of tooling equipment are shown merely to indicate the wide range of special devices that the tool engineer must provide before a commercial automobile can be produced.

WIRE-HOLDER FOR INACCESSIBLE SCREWS

By A. L. VARGHA

It is often necessary to insert or remove screws in inaccessible places where difficulty is experienced in holding the screw while applying the screwdriver or socket wrench. In cases of this kind, the writer has found the following method a convenient procedure. Take a piece of wire of suitable length, and form a hook on one end which will snap tightly over the body of the screw close to the head; then bend the other end into a loop for a handle. A dead soft wire would not do, because the hook must have sufficient spring to hold the screw quite securely.

With this device it is easy to hold the screw in

Fig. 17. The Connecting-rod is Placed in the Babbitting Machine and Babbitt is Poured out of the Ladle Held by the Operator

position in front of the tapped hole while turning it with the screwdriver. After the screw is started, so that it will not fall out, the hook can be slipped off by pushing down the wire and spreading the hook with the end of the screwdriver. In removing a screw, the procedure is reversed; that is, the screw is partly removed, the hook snapped on, and the removal completed.

* * *

A new arc-welding laboratory is being built at the East Pittsburgh Works of the Westinghouse Electric & Mfg. Co. This structure will be 75 feet wide, 170 feet long, and 40 feet high. It will house a 50-ton crane, and in addition to arc-welding equipment, it will contain massive rolling and forming equipment to be used for forming the various parts of welded machinery, such as motor frames, generator frames, motor rotor rims, and motor end bells.

Industrial Prosperity and Fair Wages

By JACOB D. COX, Jr., President and General Manager, Cleveland Twist Drill Co., Cleveland, Ohio

IN the two articles, "The Economics of the Wage Problem," published in August MACHINERY, page 907, and "Prices, Profits and Wages," published in September MACHINERY, page 37, the author has outlined the principles underlying our industrial economic conditions.

We have seen that the level of wages is a subject on which the real interests of wage earners and employers are united, that conflict is wholly illogical, and that the best results for all classes will flow from a wage level that is the result of natural adjustments to world-wide economic forces. Such a level will insure reasonably full employment for both capital and labor. Working within the confines of that national level, fair wages for any trade or group depend on a fair relation between the earnings of that group and the earnings of all other groups and classes in the nation. Manifestly such a fair relation can be best obtained by opening the channels of employment to all on equal terms, for then every individual is at liberty to seek the job that suits and pays him best, and every employer has full liberty to hire such men as will give the most efficient service. Under such conditions, the public will be best served and the individual most justly rewarded. In all human affairs, some imperfections are inevitable, but universal freedom in the wage market will certainly bring a higher average attainment of justice for all groups, and a greater degree of individual satisfaction and acceptance, than any other rule that could be laid down.

Since the average prevailing standard of living is the maximum possible with our present productive ability, it is clearly impossible to raise the wages or the standard of living of any selected group of workers without conferring on them special privileges at the expense of the remainder. The average standard of living, be it high or low, is not a condition for which employers alone are responsible, but one which modern industry is constantly doing its best to improve. Progress in this direction can be hastened only by intelligent cooperation on the part of both employers and employes.

Many people, influenced by the old ideas, are disposed to seek some other basis of justice, and we hear loud demands for the so-called "living wage," collective bargaining, and a shorter work week. A brief discussion of the claims of each of these is therefore desirable.

The "Living Wage"—How is it Determined?

The demand for a "living wage" is founded on the conception that it is possible for someone to tell what minimum wage everyone should really have, and that it is further possible for society to pay such a predetermined figure. Both of these conceptions seem to be contradicted by the facts. The Bureau of Labor Statistics in the Federal Department of Labor estimated, as the minimum standard of health and decency for a family of five in 1919, a minimum living wage of $2262, while in the same year the Bureau of Economic Research reported that the total national income of the people of the United States amounted to about $1670 for each person gainfully employed; so that if all the income accruing to capitalists and landlords in the form of interests, profits, and rents had been confiscated and the entire income of the nation divided equally among all those working for a living, there would still have been a deficit of approximately $600 for each such person. Figures that can lead to such fantastic results cannot be accorded any scientific standing. Were any particular group or class to have their wages fixed on the basis of such estimates, it is clear that the balance of the people would find that their purchasing power was automatically restricted, to the extent of the favors being granted to the privileged few.

In 1922 the Railroad Labor Board rejected the claims of the railway employes for a minimum wage based on such methods of figuring. The result was the great railroad strike of that year and ultimately the abolition of the Labor Board itself, but it seems impossible to escape the conclusion that the decision was based on sound reasoning.

If, as we have seen, the prevailing standard of living is the maximum possible with our present productive ability, and the workers do in fact receive the residual share of production, then clearly it is impossible to raise the return of any selected group without conferring on them special privileges at the expense of the remainder; nor can such a principle be extended equally to all groups, in defiance of the economic forces that regulate the wage level, without incurring the gravest consequences.

The inadequacy, if we care to use that word, of the average standard of living is not a condition for which employers are responsible, but is one which modern industry is doing its best to improve and alleviate. The standard of living today is far and away better than it was but a few years ago, and is steadily improving. This progress can be hastened by intelligent cooperation among all groups, but it cannot be improved by coercive measures. Whether depending on the force of law or on organized economic pressure, such methods can only bring division and conflict, which will delay progress and not accelerate it.

Collective Bargaining and its Results

Collective bargaining is of two kinds: First, that which is genuine bargaining in that it consists of reasonable and fair discussion based on the facts of the labor market. Such genuine bargaining is becoming more and more common between em-

ployers and employes. It accepts the conception that fair wages for any group is a matter of right relation to the wages paid to other groups and classes in the community. The great mass of American workmen are accustomed to think in this way and accept such a standard of fairness as proper and legitimate; but there is an organized minority who object that such bargaining does not give the workers adequate representation. They regard the company union as a device of the employer to cheat the worker of his rights, and demand collective bargaining conducted by union representatives on the basis of the Closed Shop. With a monopoly of labor organized in this way, there ceases to be any kind of reasonable discussion, and the matter becomes instead a contest, based on force, involving all the incidents and the psychology of warfare. Bargaining in its proper sense ceases, and the question becomes a matter of coercion with a demand, and a surrender, or a conflict in which the issue depends on the ability to marshall the greater power. Such an atmosphere makes impossible any cooperation between employers and employes, and substitutes instead the constant preaching of class antagonism and class hatred.

The Best Way to Determine Fair Wages

There may be times and conditions when such tactics are justified for the time being. There still are some employers of the autocratic type who need the curb of an organized opposition, and there have been times in certain industries when wages were unreasonably depressed below a fair market level. Under such conditions, the Closed Shop organization of the workers is perhaps the most effective remedy, but such conditions, fortunately, are seldom met with today. The real determinant of fairness is whether wages being paid in any industry are in fair relation to the general level of wages in the community. Those who have armed themselves with coercive force and who resort to lawlessness and intimidation to enforce their demands are not always themselves impartial judges as to what their scale of wages should be.

In the absence of some failure in competition, or in the mobility of labor, individual freedom in the wage market is far more likely to secure a wage that will be just and reasonable, both to those who receive it and to the ultimate consumer who must pay for it, than a wage based merely on the balance of power. Surely nothing is clearer to modern minds than the fact that warfare does not always promote justice, and that where a clear principle of justice can be discerned, warfare ought to be suppressed and brought under the rule of law.

How Hours of Work Influence Wages

Since the residual share of production goes to the wage earner, any unnecessary and artificial restriction of output ultimately makes itself felt in a lower purchasing power of wages. More production per hour and per week creates higher purchasing power for the worker's wages, and reduced production cannot fail to lower it. The question of hours thus becomes a compromise between greater purchasing power or greater leisure for the wage earner. The usual demand for shorter hours in industry is coupled with the demand that the weekly earnings of the workman should remain at least as high as before. This means, of course, a higher wage per hour and a higher cost for the product, unless production increases sufficiently to compensate for the reduction of hours. Sometimes this is accomplished, but more often it is not.

In general, it would not seem that the consuming public ought to be obliged to pay more for the necessities of living in order to provide greater leisure for the producers, unless the latter are working longer hours than are reasonable. Where hours are in reasonable relation to those generally prevailing, further reduction ought to be conditioned, in justice to the public, on a reduction in earnings equal to the decline in productivity.

High wages depend upon high production; hence, any artificial restriction of output ultimately results in lowering the purchasing power of wages. More production per hour and per week creates higher purchasing power for the workers' wages; reduced production cannot fail to lower it. The question of hours of work, therefore, becomes a compromise between greater purchasing power or greater leisure for the wage earner. It is seldom that production can be immediately increased sufficiently to compensate for a reduction in hours. Sometimes this can be done, but more often not.

If there is no decline in production, the workers would suffer no loss, but if hours are shortened for their benefit, they ought to be willing to assume any loss involved and not ask that it be passed along to the consumer. Of course, where hours are excessive and unreasonable, reductions should be made to bring them in line with the prevailing standard, and wages should not suffer; but on the other hand, the public should not suffer an advance in its cost of living for the benefit of a few who may have the power to demand and secure greater leisure for themselves.

If these principles were generally adopted, the question of hours as a controversial one would eliminate itself. For it thus becomes a question for the wage earners themselves to decide whether they prefer reduced hours with reduced pay, or longer hours with increased earnings, and the matter may be fairly left to their own decision, especially since this is precisely the alternative that society as a whole faces. There has been a marked reduction of hours in recent years, and undoubtedly there will be further reductions as the efficiency of industry increases and the consequent rise in the standard of living permits; but it is unjust to hasten such reductions unduly for the benefit of a few, at the expense of the consuming public. In other words, the rule of fairness as to hours is precisely the same as the rule for wages: They must be fair and reasonable in relation to those generally prevailing. Society, as a whole, may be trusted to adopt such hours as best suit the needs of the average man, under the prevailing conditions of production.

Concluding Remarks

These brief articles have covered a great deal of ground, but the argument naturally cannot be as

detailed or as clear as in a longer exposition. A year ago, I wrote a text of 140 pages, setting forth these general ideas in much more detail and, of course, covering many points that these brief articles must, of necessity, leave unmentioned or take for granted.

As an experiment, we tried this text in the plant of the Cleveland Twist Drill Co., at first with a group of about a dozen foremen. .Two results immedately appeared, for which we were hardly prepared. The men took a surprisingly deep interest in the text. One would have thought that such abstract ideas and discussions would be over the head of the average factory man, but to our surprise we found that they were much more interested, as a rule, than an equal group of business or college men would have been. The explanation seems to be that the subject comes close home to the shop man. It is bread and butter to him and he is intensely interested.

The second result was that the men accepted the conclusions when they had once grasped the drift of the argument. This was so encouraging that we extended the group and organized other groups until about 15 per cent of the men in the plant had joined in one or more of them. The results have been a marked improvement in understanding between men and management and the finest spirit of cooperation that we have ever known. The men are joining wholeheartedly in efforts to increase efficiency and lower costs, and the results are quite apparent both in the balance sheets of the company and in better relations with the men. I should probably add that we have a profit sharing plan, which pays a dividend on wages each year in proportion to the earnings of the company, and this has undoubtedly made a substantial contribution also to the excellent conditions prevailing.

[This is the last of three articles by Mr. Cox on the economic basis of fair wages.—EDITOR]

* * *

SAVING TIME IN DETAILING

By JOHN W. GARDINER

The practice of describing small parts in words alone, instead of making a drawing, as mentioned on page 857 of July MACHINERY, is often advantageous. In sheet-metal construction for all-metal aircraft, it is customary to have the same drawing serve for both detailing and assembly work. Many times a new job is very similar to an existing job, in which case only the changes are actually drawn in detail; the balance of the assembly is merely a phantom over-all line with a reference note to the original drawing.

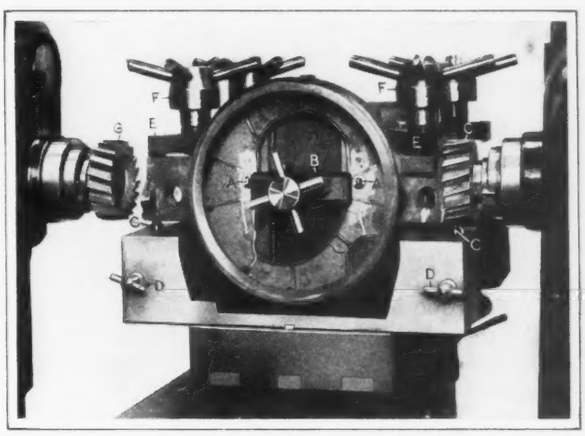
When words alone might be confusing, a small freehand sketch giving merely an outline of the original detail with a full-line drawing and dimensions of the additional work required will often answer the purpose. Many parts may be specified merely by their trade name and number. Large units purchased under a trade name and installed as an additional part after the original assembly is in service may be best shown by a photograph which indicates how the special unit is applied. This is often clearer than the use of a three-view drawing.

MILLING PADS ON FLYWHEEL HOUSINGS

By HOWARD ROWLAND

The equipment used in milling the support pads of a flywheel housing shown in the accompanying illustration enabled these parts to be produced at the rate of 1.27 minutes each. The flywheel housing is located in the fixture by dowel-pins *A*, and clamped securely in place by clamp *B*. The projecting arms are supported from below by plungers *C*, which are forced up by wedges operated by screws *D*. The arms are clamped on top of these plungers by clamps *E*, operated by nuts *F*.

Two fixtures are mounted on an index base back to back on the same center line, one at each extremity of the index base, so that one fixture can be reloaded while work is being milled in the other fixture. The 6-inch diameter shell end-mills *G* are mounted on stub arbors in the spindles of the duplex miller. These spindles have a horizontal as well as a vertical adjustment. The illustration shows a



Milling Flywheel Housing Support Pads

rear view of the machine, in order to give a clear idea of how the cutters mill the work.

The operation of the milling cycle is almost entirely automatic. When the feed is thrown in, the work advances toward the cutters. Then, when the full cut has been made, a clutch is tripped and the table automatically reverses, the index base is indexed 180 degrees by hand, and the table again advances toward the cutters. The operator's position relative to the machine is always the same, and his work consists merely of loading and unloading the fixtures.

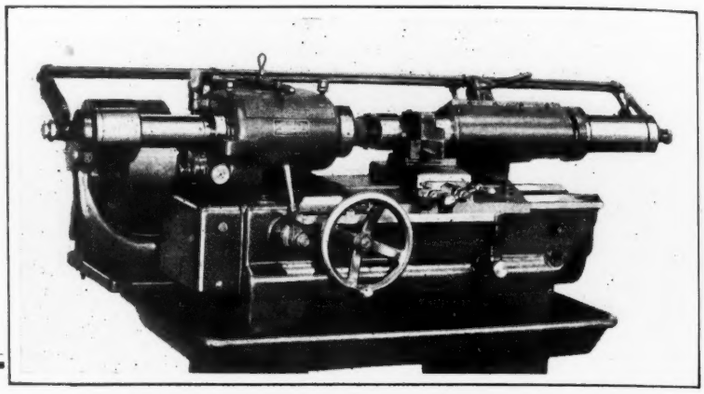
* * *

Until recently, all welded steel building structures have been either promoted, fabricated, or erected by companies who manufacture welding machines or equipment, and who have interested themselves financially to promote their products in the publicity such buildings would obtain. The Thew Shovel Co., Lorain, Ohio, is the owner of the first industrial building whose steel framework was arc-welded by a structural steel fabricator on a purely commercial basis. The building is a one-story structure, approximately 35 by 100 feet. Fabrication was effected by electric arc welding in the shops of the Republic Structural Iron Works, Cleveland, Ohio, Lincoln welding equipment being employed in this case.

Air Chuck Designs

Pneumatic Chucking Equipment for Various Types of Machine Tools

By CHARLES O. HERB



AIR-OPERATED chucking devices frequently offer a means of reducing the loading time of operations, because they can be instantaneously opened or closed by simply turning a valve handle. Other advantages of air chucks were brought out in an article published in September MACHINERY, which also described equipment of this classification built by the Logansport Machine Co., Logansport, Ind. Several additional examples designed by the same concern and embodying interesting construction features will be presented in this article.

Pneumatic Collets on Headstock and Tailstock of "Manufacturing" Lathe

Both the headstock and tailstock of the Sundstrand "Manufacturing" lathe shown in the heading illustration are equipped with air-operated collets for gripping the shaft of small motor armature assemblies. The two collets are controlled through a single valve mounted on the tailstock, the two air cylinders being piped together. When work is placed in the machine and the valve is operated to chuck it, the collet of the headstock tightens first on the end of the armature shaft. This is due to the fact that the piston of the headstock cylinder has a stroke of only 1/8 inch and, as a consequence, a small amount of air suffices to operate it.

The tailstock sleeve, in the meantime, has started to approach the work, and continues, forcing its collet over the opposite end of the work, until it comes against a shoulder. The piston of the tailstock cylinder has a stroke of 5 inches, which permits rapid loading and unloading. This cylinder is of the non-rotating type and has a 3-inch bore, while the headstock cylinder is of the rotating type and has a 6-inch bore. The armature shaft extends a considerable distance into each collet, so as to insure an accurate set-up of the work. Rough- and finish-turning cuts are taken simultaneously on the armature in this machine.

Mandrel for Chucking Automobile Pistons

An air-operated mandrel of the construction illustrated in Fig. 1 was designed for holding cast-iron automobile pistons in a lathe operation. This operation is the first one performed on the pistons and consists of turning the outside, turning the ring grooves, facing both the skirt and closed ends, center-drilling the closed end, and boring the skirt end. For securely gripping the piston, four pins *A*, having serrated outer ends, and three pins *B*, having plain outer ends, are forced against the rough inside of the piston wall. These pins are placed at such an angle from the center of the mandrel that they do not interfere with the bosses on the inside of the piston. The entire operating mechanism of the mandrel is contained in a holder *C*, which is assembled into the headstock spindle of the machine. The piston-rod of the air cylinder is connected to plunger *D*.

When the mandrel is contracted to permit loading, the piston can be readily slipped over pins *A* and *B*. Then as air is admitted into the cylinder and the piston moves forward, plunger *D* forces rod *E* forward, so that the tapered nose of the rod acts on the inner ends of pins *A* and pushes them against the work. At the same time, through the pressure exerted by spring *F*, sleeve *G* is advanced to expand pins *B* against the work. Cross-sections of the noses on sleeve *G* and rod *E*, taken at right angles to the sections shown, are diamond-shaped.

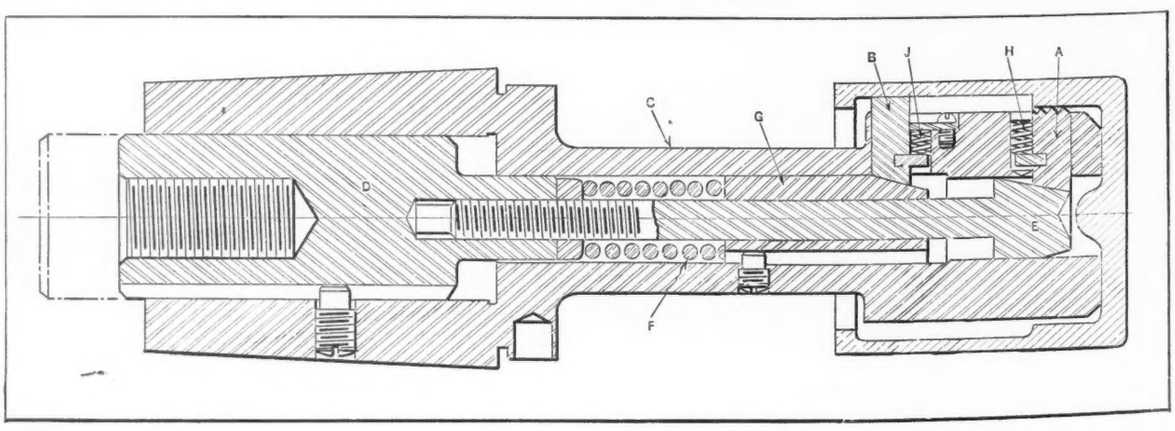


Fig. 1. Pneumatically Operated Mandrel Used in Chucking Cast-iron Automobile Pistons

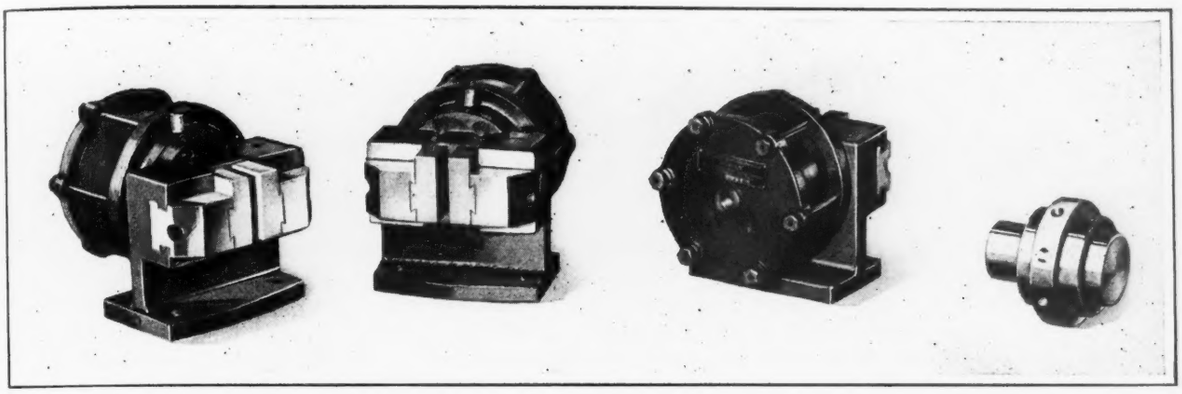


Fig. 2. Air-operated Fixtures of Simple Design Suitable for Mounting on Indexing Tables of Machines

At the end of an operation, as rod *E* and sleeve *G* are withdrawn by admitting air into the opposite end of the cylinder, small coil springs at *H* and *J* act on pins fastened in the sides of pins *A* and *B*, causing the latter to contract. Rod *E* has a backward and forward movement of 1 inch. The under side of the head on rod *E* strikes the nose of sleeve *G* and forces the latter backward when work is being released. By having sleeve *G* separate from rod *E* any wear on the noses or on the inner ends of the pins with which they come in contact is automatically compensated for.

Fixtures Applicable to Indexing Tables

Fixtures of the type shown in Figs. 2 and 3 have been developed for use on the indexing tables of drilling machines, etc., eight of these fixtures being employed in one installation. They are arranged radially around the table, and all cylinders receive air from a distributor located in the middle of the table. This distributor is shown at the extreme right in Fig. 2. The fixtures are intended for holding small parts, such as brass pipe ells, tees, etc., vertically.

From Fig. 3, which shows a plan sectional view of the fixture, it will be seen that the two jaws *A* are moved together or apart through the action of levers *B*. These jaws are equipped with false jaws having gripping surfaces that are shaped to suit the work. Levers *B* are fastened on their inner ends to blocks held in collar *C*, which is attached to the front end of the piston-rod. Piston *D* has a stroke of 1/2 inch, which gives a 1/4-inch movement to the jaws *A*.

A clamping unit designed for similar applications is shown in Fig. 4. This fixture is equipped with a single movable jaw *A* which is operated to and from the stationary jaw *B* of the housing through the action of yoke *C*. This yoke, which engages a block held in the bottom of jaw *A*, is connected to the rod of piston *E* through link *D*. Piston *E* has a stroke of 1 inch, and imparts a movement of 1/2 inch to jaw *A*, the leverage of yoke *C* being 2 to 1. The cylinder has a bore of 3 inches.

* * *

CARBON PAPER UNDER PENCIL DRAWING GIVES BETTER BLUEPRINTS

By JOHN REIK

Blueprints made from pencil drawings are often unsatisfactory because the pencil lines offer comparatively little resistance to the passage of light, giving the blueprints a weak or "washed out" appearance. By placing black carbon paper underneath the drawing paper, with the carbon-coated surface upward, better results can be obtained. The black lines on one side, and the ordinary pencil lines on the other, offer considerable resistance to the passage of light, so that clean-cut blueprints result, provided suitable drawing-paper is used.

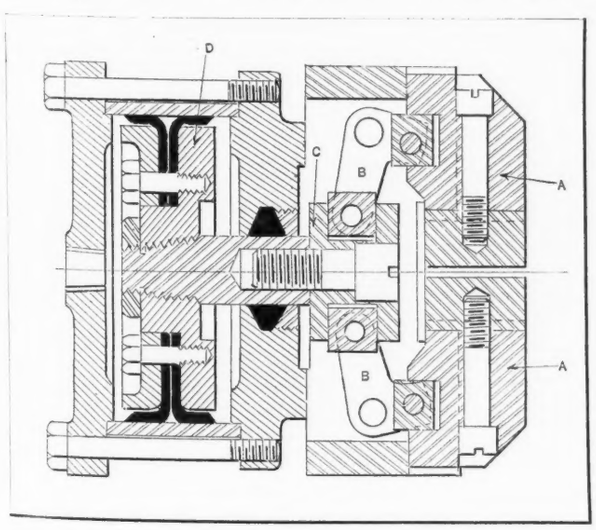


Fig. 3. Construction of a Fixture Such as Illustrated in Fig. 2

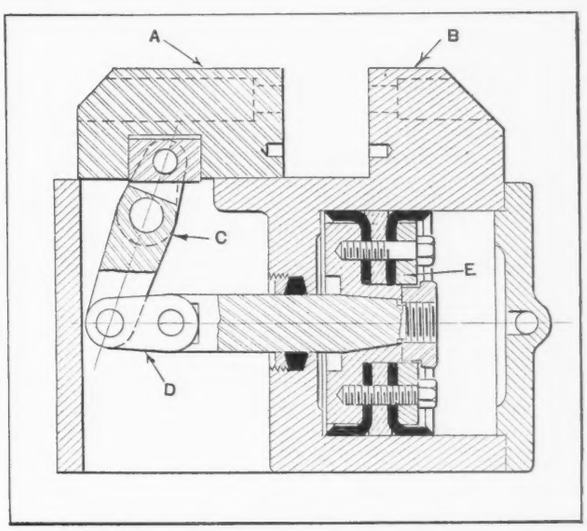


Fig. 4. Air-operated Vise Having a Movable Jaw that is Moved Back and Forth 1/2 Inch

When and Where to Use Grease as a Lubricant

By H. L. KAUFFMAN, Consulting Petroleum Chemist and Lubricating Engineer, Denver, Colorado

FROM time to time the writer of this article receives inquiries from users of large quantities of industrial lubricants asking whether grease or oil is more suitable as a lubricant for use on a particular machine. The reply usually given is: Do not use grease for lubrication if oil can be used just as conveniently. However, this statement demands further explanation.

Greases are desirable lubricants under one condition, while oils are more suitable under different conditions. The type of lubricant to employ, that is, whether an oil or a grease, must be determined from an operating viewpoint. Hence the choice of a lubricant involves a consideration of machinery details and the ready adaptability of each lubricant for the service intended. Therefore, the more intimate knowledge of machinery operation and the basic principles of lubrication that one possesses, the better will one be enabled to select the proper type of lubricant for use on a particular mechanism.

Classification of Greases

Greases that are on the market today, with the exception of certain greases of a special type, can almost all be placed under four classes as follows: (1) Cup greases. (2) Cold-set rosin or axle greases. (3) Railroad-engine greases. (4) Fiber or sponge greases.

Cup greases are made by saponifying a fatty oil with slaked lime, forming the soap either in the presence of a small amount of mineral oil or without adding any mineral oil until after the soap is made. Axle greases are made by mixing, while cold, the proper proportions of mineral oil, rosin oil (or a mixture of rosin and rosin oil), and slaked lime or "set." Railroad-engine greases are made by the cold saponification of fats or fatty oils with caustic soda in the presence of the proper amount of mineral oil.

Fiber greases are boiled greases of the soda-soap type. As in the case of cup greases, fiber greases are made by saponifying a fat or fatty oil either in the presence of mineral oil or without the addition of any mineral oil until after the soap has been made. A large variety of greases can be made by variations of mixtures of lime and soda soaps in mineral oils. Such greases are made to meet certain unusual lubricating conditions.

Calcium-soap greases are suitable for use only under normal temperature conditions. Straight, calcium-soap greases should not be used at temperatures above 165 degrees F. Another characteristic of lime-soap greases is the fact that they are insoluble in water, and hence, no straight calcium-soap grease will lubricate wet surfaces. Sodium-soap greases, on the other hand, are water-soluble and, for this reason, are entirely satisfactory for the lubrication of wet surfaces. Because of their high melting points, greases containing soda soap are especially suitable lubricants for high-temperature conditions. In this respect, they are different from calcium-soap greases, which prove most satisfactory when used under normal temperature conditions.

When Use of Grease is Advisable

The particular conditions of lubrication for which it is either advisable or necessary to use grease as a lubricant may be classified as follows:

1. When high-pressure, slow rubbing speed, or high operating temperature, causes oil to be squeezed out from between the rubbing surfaces, and the oil cannot be retained in and around the bearing.
2. When the lubricant must act as a shock or noise absorber—for example, in the lubrication of gearing in sugar and steel mills, more especially gears with worn or poorly fitting teeth.
3. When a lubricant that must retain its position by virtue of its physical characteristics is required, regardless of whether the machine is idle or in motion—for example, in the lubrication of locomotive driving journals.
4. When the application of oil might result in splashing or dripping from the lubricated surfaces, as a consequence of which the belting or the materials handled by the machine might be injured, or when splashing might prove a source of discomfort to workmen. An example of a condition where oil splashing might damage the materials handled is in the lubrication of machines in textile mills.
5. When the operation of the bearing is intermittent, so that if oil were used it would flow from the bearing surfaces between applications made at reasonable intervals, and hence more labor would be required to replace such oil lubricants than if grease were used.
6. When relatively high operating temperatures are encountered, unless the machinery being lubricated is equipped with a suitable oil applying and recovering attachment. Such conditions of lubrication occur in steel mills, paper mills, and chemical plants.
7. When the design of the machine is such that the bearings are not readily accessible, and the use of oil would entail shutting down the machinery for attention. In other words, grease should be used when it is desirable to insure positive lubrication, using a comparatively small amount of lubricant, and yet have a sufficient reserve so that the parts can function satisfactorily with relatively little attention for a considerable length of time.
8. When the greater film thickness maintained by grease on the part being lubricated, as compared with oil, more than counterbalances the greater resistance of the grease, due to its high consistency. Such conditions are encountered in the lubrication

of certain bearings operating at very slow speeds or with great clearance, wherein the frictional coefficients will be lower when grease is used than when oil is used.

9. When the total frictional loss in bearings, using grease, is a negligible quantity, as compared to the frictional losses at other parts of the machine—for example, in the lubrication of the Stephenson reversing gear.

In general, grease should not be used as a lubricant in cases of relatively high speed, or wherever oil can be applied effectively and will be retained by the bearing, unless other exceptional conditions (such as those outlined in the foregoing) warrant the use of grease. Furthermore, greases should never be used where contact with steam may be possible, and the exhaust steam thereafter returned to the boiler feed. In addition to the factors thus far mentioned, the type of equipment available for applying the lubricant to the parts to be lubricated is also of importance in determining when and where to use grease.

Where Grease Can Well be Used

In the following are listed specific conditions of lubrication where grease can well be used as a lubricant, together with suggestions as to the general class of grease that will give satisfactory results:

1. Lubrication of axles and rough journals. Use an axle grease, which is composed essentially of the lime soap of rosin acids and mineral oil.

2. Lubrication of slow-moving gears and pinions. Use an adhesive grease that will serve both to reduce noise and to keep the surfaces from actual contact with each other, thereby reducing wear. Heavy, sticky petroleum residuums, either used alone or compounded with rosin, or rosin oil, or pine-tar pitch, or other materials, are employed for this purpose, as well as lime-resinate greases. Gears and pinions enclosed in an oil-tight case are usually lubricated with a straight mineral oil.

3. Lubrication of cold necks and other rough mill bearings. Use so-called "cold-neck grease," which is usually a viscous, tacky, black or dark-colored grease, composed of the lime soap of rosin acids and viscous black oils or petroleum residuums.

4. Lubrication of hot necks and other rough mill bearings operating at high temperatures. Use so-called "hot-neck grease," which is a grease of high consistency and high melting point. Hot-neck grease must be capable of adhering to journals at high temperatures. Most greases of this type are very hard, and are usually composed of the lime soap of either fatty or rosin oil, and a heavy residue (such as wool pitch, stearin pitch, petroleum pitch, or a heavy lubricating oil), to which is also added either finely pulverized talc or graphite.

5. Lubrication of journal bearings and other machine parts where the power loss due to friction is a real consideration. Use cup greases, which are lime-soap greases. The grade of cup grease to be used depends upon the method of applying the grease to the bearing and the temperature under consideration. For the lubrication of journal bearings that either are pitted or possess large clearance, use cup grease containing from 5 to 20 per cent of flake graphite.

6. Lubrication under water. For lubricating conditions where the grease is subject to the action of water, as, for example, elevator and plunger-pole greases, use lubricants that are essentially compounds of animal and mineral oils, or greases containing soda soaps.

7. Lubrication of ball and roller bearings. If the bearing is constructed to contain oil, use a mineral oil of low viscosity; otherwise, use either a pure petroleum grease, such as highly refined petroleum or a well made cup grease.

Grade of Grease Most Suitable for Use

In determining the proper grade of grease that should be applied to bearing surfaces, the following points should be borne clearly in mind:

1. Low speeds require the use of a grease of stiff consistency; high speeds, one of soft consistency.

2. High pressures require a grease of stiff consistency.

3. Shock conditions, likewise, require that a grease of stiff consistency be employed.

However, either the method followed in applying the grease, or some other particular condition of operation, may entirely change the choice of the most suitable grease. For example, a grease that is applied to a bearing by gravity must be of a very fluid consistency; one that is fed by hand-feed cups should be of a medium-bodied consistency; while the application of the grease by means of powerful screw-fed cups permits the use of greases of much stiffer consistency.

Some greases are of such hardness that they are solid blocks. In applying greases of this kind, as, for example, in the lubrication of large bearings in paper mills, a block of grease rests upon the journal and is applied gradually to the latter by abrasion. Some bearings are lubricated by means of a cup in which the grease is slowly melted by the heat transmitted to it from the journal, the journal, in turn, being heated by a copper rod which rides upon it. When grease is applied by this method, the melting point of the grease, rather than its consistency, is the primary factor in determining the grade of grease to be used.

Speed, as mentioned in the foregoing, refers to bearing surface speed, and not to revolutions per minute. Bearing surface speed may be defined as being the number of feet of shaft or journal surface passing a given point on the surface of the bearing metal in one minute. Bearing surface speed may be determined by the use of the following formula:

Bearing surface speed = Diameter of shaft in inches $\times$ revolutions per minute $\times$ 0.26 (a constant).

For example, let us suppose that it is desired to know the speed of a 4-inch shaft, which is moving at the rate of 200 revolutions per minute. Then:

$4 \times 200 \times 0.26 = 208$ feet per minute

Grease for Different Bearing Surface Speeds

Depending on bearing surface speeds, the following general recommendations are made as to the consistency of grease that will prove most suitable,

the consistencies mentioned being merely relative, since thus far the products made by various grease-makers for greases supposedly of the same consistency are not uniform:

1. High speed (above 300 feet per minute), use grease of No. 0 consistency.

2. Medium high speed (from 200 to 300 feet per minute), use grease of No. 1 consistency.

3. Medium speed (from 100 to 200 feet per minute), use grease of No. 3 consistency.

4. Low speed (from 0 to 100 feet per minute), use grease of No. 5 consistency.

However, bearing surface speed is not the only consideration. A 4-inch shaft turning at 200 revolutions per minute has the same bearing surface speed as a 3-inch shaft turning at 267 revolutions per minute; but the 4-inch shaft is capable of transmitting almost twice the horsepower. Furthermore, the shaft of larger size is more likely to show an increase in pressure on the bearings, due to tightening of belts, misalignment, etc. Shafts of large diameter usually have longer bearings to compensate for the increased stresses. Nevertheless, where shafts are above 3 1/2 inches in diameter, and the amount of power transmitted is high, a grease of the next higher consistency than given in the foregoing should be used.

The character of the work being done by a plant also influences the determination of the consistency of grease that should be used. Most heavy machinery subject to shocks, such as cement and grinding machinery, runs at from medium to low speeds. Hence, because of the shock conditions encountered, greases of heavier than usual consistency should be used. In lubricating machinery where the use of a No. 3 grade of grease ordinarily would satisfy both speed and pressure requirements, a No. 5 grease should be used if the machine is subject to shocks. For the lubrication of machinery in which high speed is combined with heavy pressures or shock conditions, it frequently happens that special lubricants capable of meeting such conditions of lubrication satisfactorily must be manufactured. The advantages and disadvantages of greases as lubricants and their properties will be dealt with in a succeeding article.

* * *

The newspaper man who has to report on an occurrence involving engineering expressions has difficulties of his own. According to the *Locomotive*, published by the Hartford Steam Boiler Inspection & Insurance Co., one newspaper recently stated, in telling of the failure of a steam pipe, that "it threw 250 pounds of steam on the engineer." Scarcely less remarkable is the performance of an engine which ran away because the governor failed, resulting in a flywheel explosion. According to the newspaper report the engine "ran off."

Building Big Guns for Uncle Sam

The leading article in November MACHINERY will illustrate and describe a number of machine shop operations in the building of big cannon at the Watervliet Arsenal. At this great government manufacturing plant are produced all the cannon for the War Department. Guns ranging in size from 37 millimeters (less than 1 1/2 inches) to 16 inches are built here. The article will describe primarily the unusual machine shop operations required in constructing the large 14- and 16-inch guns, the latter being capable of firing a projectile weighing 2400 pounds through a distance of thirty-one miles. These guns are nearly 70 feet long and weigh approximately 200 tons, not including the breech mechanism.

GETTING BEST RESULTS FROM PRESSES

In a paper read before the Rugby Engineering Society, W. A. Lynch gave the following general suggestions for improving press production work:

1. Ample floor space should be provided around all presses, especially drawing presses, to accommodate work.

2. Shells and other work waiting for further operations should be stored in covered bins. This will help to keep the work clean and hence will prolong the life of the dies. Scratches and marks that often occur on drawing dies are due in many cases to dust and foreign matter collected in exposed bins between operations.

3. No operation should be commenced on a press until some responsible person is satisfied that the operator fully understands (a) the working of the press, and (b) the working of the tools.

4. Blanking and piercing operations should never be done on the inside rams of double-action machines.

5. Tool-setters should be instructed that cutting punches should be set to give a minimum punch entry, and never an entry of more than 1/16 inch, unless this is unavoidable.

6. When adjusting heavy rams, it is advisable to lower them and allow their weight to be taken by blocks of wood before releasing any locknuts or collars.

7. Single-roll feeds, when stock is being fed at right angles to the crankshaft, should preferably be fixed at the front of the machine. In this way, the operator is not inconvenienced by the outcoming oily scrap.

8. Double rolls are better than single rolls, especially for thin stock. They have the advantage of being able to feed strip through its entire length, and also of preventing the strip from puckering.

9. For all work, tool-setters and inspectors should be provided with blueprints showing the nature and dimensions of the work to be produced by the operations in the proper sequence.

10. Tool-setters and inspectors should be furnished with operation charts, giving the following information: Part name, number and drawing number; material and size of blank, work performed at each operation; tool drawing number; machine (and alternative machines); lubricant to be used; annealing temperatures, if necessary; remarks peculiar to any operation.

* * *

In 1910, less than 250 automobiles were imported into the Philippine Islands. In 1912, when the registration law was first enforced, some 1600 automotive vehicles were registered. At the end of 1927 there were approximately 28,000 motor vehicles in operation. The United States exported 93 per cent of these.

Special Tools for Railway Shops

MANDREL FOR HOLDING LOCOMOTIVE PISTON-VALVE FOLLOWER HEAD

By E. A. LOTZ, Shop Foreman, Pennsylvania Railroad Co.

The mandrel for holding locomotive piston-valve followers shown in the accompanying illustration has effected a great saving in machining time. One end of the mandrel is held in the lathe chuck, and the other end is supported by the tailstock center. The piston-valve follower head undergoing repairs is required to be faced on the surfaces *A* and *B*.

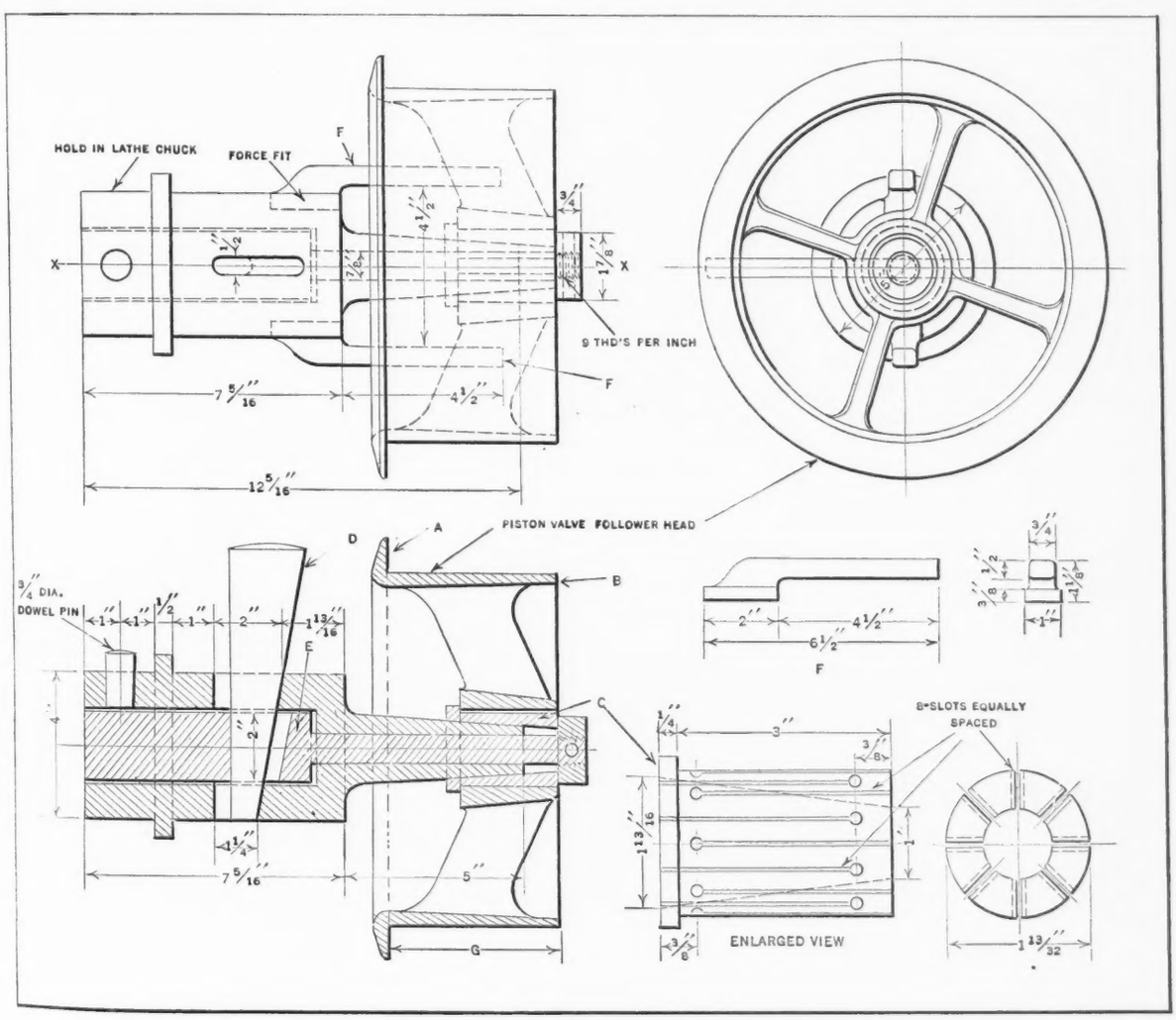
After the work is placed on the mandrel, the taper key *D* is given a slight blow with a hammer. This causes the rod *E* to draw the split bushing *C* back on the tapered end of the rod. Bushing *C* is thus caused to expand and grip the work securely. Two arms *F*, which engage the webs of the work, insure a positive drive. A double tool-holder equipped with two facing tools is employed for facing the surfaces *A* and *B* simultaneously. As the cutters are accurately spaced or positioned in the holder, it is possible to hold the dimension *G* within accurate limits.

A SCAFFOLD THAT IS ADJUSTABLE AND PORTABLE

By H. C. DUSTIN, Foreman Boiler-maker, Western Pacific R. R.

The work of repairing locomotives in a railway shop frequently requires the erection of temporary scaffolding, so that the workmen may conveniently reach the section being worked on. The illustration (see next page) shows a type of scaffold leg that is both adjustable and portable. An advantage of this arrangement is the fact that other men can work on the locomotive from below the scaffold while men are working on the scaffold. Formerly, four iron or wooden horses were used in constructing the scaffold, and these shut off considerable floor space adjacent to the locomotive.

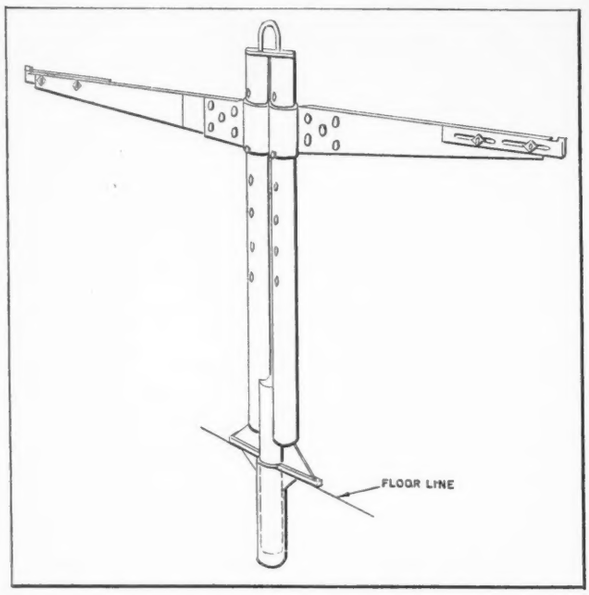
The scaffold leg illustrated is made up of two lengths of 4-inch standard pipe, welded to a comparatively short length of machine-steel rod of a diameter that will enter, without excessive play, a 4-inch double, extra-strong pipe. Short lengths of the 4-inch pipe are set into the concrete floor at



Mandrel Used on Lathe for Turning Piston-valve Follower Head

intervals along the repair line. Welded in line with the upper end of the floor pipes are grooved arms, into which are fitted locating plates that are welded to the rod and pipes of the scaffold leg so as to prevent it from turning.

Lateral arms, one on each side of the pipes, support wooden planks extending from one scaffold leg to the other. At equal distances along the two vertical pipes, holes are drilled to receive pins that support the lateral arms at the heights required.



Portable Scaffold for Railway Shop

For convenience in moving the legs with a crane from one floor pipe to another, a hook is set in the tie-plate welded on top of the vertical pipes.

* * *

CROSS-HEAD PLANING FIXTURE

By H. H. HENSON, Foreman Machine and Erecting Shop, Southern Railway Co.

A mandrel arrangement that has been used with satisfaction to set up cross-heads on a planer is shown in Fig. 1; the details of construction are clearly seen in Fig. 3. The fixture consists of two V-blocks, a mandrel, two cones, and a draw-bolt. The mandrel and two cones are made from a good quality steel and casehardened. The V-blocks are of heavy construction, which insures rigidity in planing large, heavy cross-heads without tool chatter. The taper of the cones is so made as to take

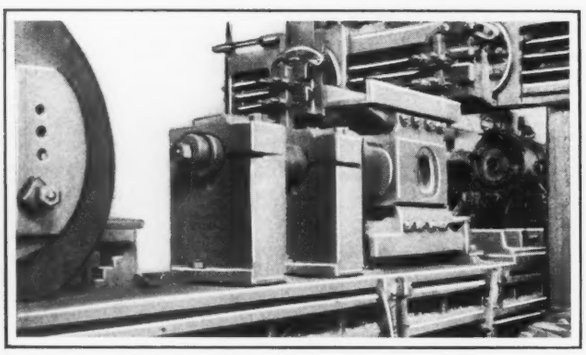


Fig. 1. Planing a Locomotive Cross-head, Held in a Special Fixture

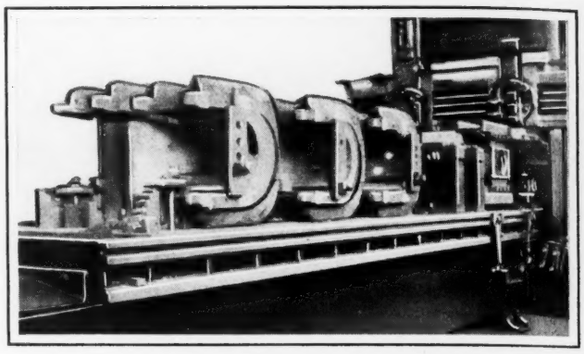


Fig. 2. Planer Table Set up for Planing Driving-boxes and Cross-heads, with a Vise for Emergency Jobs

care of the various sized holes in the cross-head in which the engine piston-rod is mounted. Setting up by means of these tapers enables the operator to draw the cross-head up quickly and easily to the correct working position. It is necessary to have only three sizes of cones *B*, as they will take care of any size taper hole in the cross-head. Cone *C* is held stationary, and will accommodate any of the sizes without changing. The outboard end of the cross-head is blocked or jacked up, and then strapped down securely on top of the jack. It has been found convenient to mount this fixture permanently on the back end of a planer table, so that the rest of the table will be ready to take care of any emergency work that may be necessary for the engine house.

The operation of setting up the cross-head on the mandrel (see Fig. 3) is as follows: The draw-bolt *A*

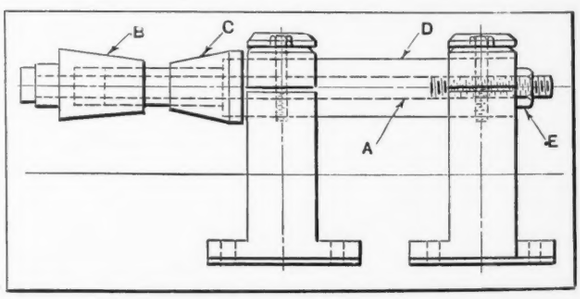


Fig. 3. Details of Cross-head Planing Fixture

and the cone *B* are first removed. The cross-head to be planed is then placed on the stationary cone *C*, the cone *B* slipped on the mandrel *D*, the draw-bolt replaced, and the nut *E* tightened. This brings the cross-head in perfect alignment with the piston-rod fit, which is essential in order to have the cross-head move freely and not bind on the cross-head bars when in operation. The time required to finish a cross-head complete is about thirty minutes.

No other kind of repair shop handles such a large variety of repair work as a railway repair shop for locomotives. Here frequently a variety of work must be done on one planer while the other planers are being utilized for other work. Fig. 2 shows a typical example. In this case, six large new driving-boxes are being machined simultaneously. They are clamped to a faceplate or parallel bar which is bolted to the planer table. On the other end of the planer a cross-head is being machined in the fixture previously described. A vise for holding any rush job is bolted on the front end of the table.

TABLE FOR FINDING TAP DRILL SIZES FOR U. S. THREAD*

Threads per Inch	Per Cent of Full Thread							
	100	95	90	85	80	75	70	65
	Double Depth, Inches							
2 1/4	0.5774	0.5484	0.5196	0.4908	0.4618	0.4330	0.4040	0.3752
2 3/8	0.5470	0.5196	0.4922	0.4648	0.4376	0.4100	0.3846	0.3572
2 1/2	0.5196	0.4936	0.4676	0.4416	0.4156	0.3896	0.3636	0.3376
2 5/8	0.4949	0.4702	0.4454	0.4207	0.3959	0.3712	0.3464	0.3217
2 3/4	0.4724	0.4488	0.4250	0.4014	0.3778	0.3542	0.3306	0.3070
2 7/8	0.4518	0.4292	0.4066	0.3840	0.3614	0.3388	0.3162	0.2936
3	0.4330	0.4112	0.3896	0.3680	0.3464	0.3246	0.3030	0.2814
3 1/4	0.3997	0.3797	0.3597	0.3397	0.3197	0.2998	0.2798	0.2598
3 1/2	0.3712	0.3526	0.3340	0.3154	0.2968	0.2784	0.2598	0.2412
4	0.3248	0.3084	0.2922	0.2760	0.2598	0.2436	0.2272	0.2110
4 1/2	0.2887	0.2743	0.2598	0.2454	0.2310	0.2165	0.2021	0.1877
5	0.2598	0.2468	0.2338	0.2208	0.2078	0.1948	0.1818	0.1688
5 1/2	0.2362	0.2244	0.2126	0.2008	0.1890	0.1772	0.1653	0.1535
6	0.2165	0.2057	0.1949	0.1840	0.1732	0.1624	0.1516	0.1407
7	0.1856	0.1762	0.1670	0.1576	0.1484	0.1392	0.1298	0.1206
8	0.1624	0.1542	0.1460	0.1380	0.1298	0.1218	0.1136	0.1054
9	0.1443	0.1370	0.1298	0.1226	0.1154	0.1082	0.1010	0.0938
10	0.1299	0.1234	0.1170	0.1104	0.1040	0.0975	0.0910	0.0844
11	0.1180	0.1120	0.1062	0.1002	0.0944	0.0884	0.0826	0.0766
12	0.1083	0.1028	0.0974	0.0920	0.0864	0.0810	0.0756	0.0704
13	0.0999	0.0950	0.0900	0.0850	0.0800	0.0750	0.0700	0.0650
14	0.0928	0.0880	0.0834	0.0788	0.0742	0.0696	0.0648	0.0602
15	0.0866	0.0822	0.0778	0.0736	0.0692	0.0648	0.0606	0.0562
16	0.0812	0.0770	0.0730	0.0690	0.0648	0.0609	0.0568	0.0526
18	0.0722	0.0686	0.0650	0.0614	0.0576	0.0538	0.0504	0.0466
20	0.0650	0.0616	0.0584	0.0552	0.0520	0.0486	0.0454	0.0422
22	0.0590	0.0560	0.0530	0.0500	0.0472	0.0442	0.0412	0.0384
24	0.0541	0.0514	0.0488	0.0460	0.0432	0.0406	0.0378	0.0352
26	0.0500	0.0474	0.0450	0.0424	0.0400	0.0374	0.0350	0.0324
28	0.0464	0.0440	0.0416	0.0394	0.0370	0.0348	0.0324	0.0300
30	0.0433	0.0412	0.0390	0.0368	0.0346	0.0324	0.0302	0.0282
32	0.0406	0.0384	0.0364	0.0344	0.0324	0.0304	0.0284	0.0264
34	0.0382	0.0362	0.0344	0.0324	0.0304	0.0286	0.0266	0.0248
36	0.0361	0.0342	0.0324	0.0306	0.0288	0.0270	0.0252	0.0234
38	0.0342	0.0324	0.0308	0.0290	0.0272	0.0256	0.0238	0.0222
40	0.0325	0.0306	0.0290	0.0274	0.0258	0.0242	0.0226	0.0210
42	0.0309	0.0294	0.0278	0.0262	0.0248	0.0232	0.0216	0.0202
44	0.0295	0.0280	0.0266	0.0250	0.0236	0.0222	0.0206	0.0192
46	0.0282	0.0268	0.0254	0.0240	0.0224	0.0210	0.0196	0.0184
48	0.0271	0.0256	0.0242	0.0228	0.0216	0.0202	0.0188	0.0174
50	0.0260	0.0246	0.0234	0.0220	0.0208	0.0194	0.0182	0.0168
52	0.0250	0.0236	0.0224	0.0212	0.0200	0.0186	0.0174	0.0162
56	0.0232	0.0220	0.0208	0.0196	0.0184	0.0174	0.0162	0.0150
60	0.0217	0.0204	0.0194	0.0182	0.0172	0.0162	0.0150	0.0140
64	0.0203	0.0192	0.0182	0.0172	0.0160	0.0150	0.0140	0.0132
68	0.0191	0.0182	0.0172	0.0162	0.0152	0.0144	0.0134	0.0124
72	0.0180	0.0170	0.0162	0.0152	0.0144	0.0134	0.0126	0.0116
80	0.0162	0.0154	0.0146	0.0138	0.0128	0.0122	0.0112	0.0106

*Diam. Tap Drill = Diam. of Tap Minus Double Depth for Per Cent of Full Thread Wanted.

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MACHINERY'S Data Sheet No. 140, New Series, October, 1928

Contributed By W. W. Boyd

MACHINERY, October, 1928—96-A

TENTATIVE AMERICAN STANDARD SET-SCREW HEADS

Diameter of Screw		Width Across Flats			Height		
		Maximum		Minimum	Nominal	Maximum	Minimum
1/4	0.2500	1/4	0.2500	0.241	3/16	0.197	0.179
5/16	0.3125	5/16	0.3125	0.302	15/64	0.245	0.224
3/8	0.3750	3/8	0.3750	0.362	9/32	0.293	0.270
7/16	0.4375	7/16	0.4375	0.423	21/64	0.341	0.315
1/2	0.5000	1/2	0.5000	0.484	3/8	0.389	0.361
9/16	0.5625	9/16	0.5625	0.545	27/64	0.437	0.407
5/8	0.6250	5/8	0.6250	0.607	15/32	0.485	0.452
3/4	0.7500	3/4	0.7500	0.729	9/16	0.582	0.544
7/8	0.8750	7/8	0.8750	0.852	21/32	0.678	0.635
1	1.0000	1	1.0000	0.974	3/4	0.774	0.726
1 1/8	1.1250	1 1/8	1.1250	1.097	27/32	0.870	0.817
1 1/4	1.2500	1 1/4	1.2500	1.219	15/16	0.967	0.909
1 1/2	1.5000	1 1/2	1.5000	1.464	1 1/8	1.159	1.091

All dimensions given in inches.

Formulas

Width across flats of set-screw heads shall be equal to diameter of screw D.

Minimum width across rounded corners of square equals 1.373 times minimum width across flats.

Tolerance for width across flats shall be minus $(0.020D + 0.006)$, (except for 1/4 and 5/16).

Height of set-screw heads shall be $3/4D$.

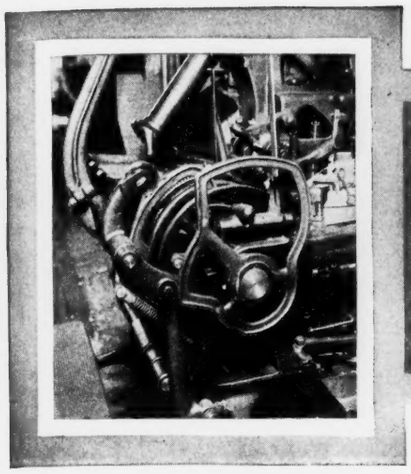
Tolerance for height of heads shall be $0.040D + 0.008$ from the minimum.

Width of neck under head shall not be over 2 times the pitch of the thread.

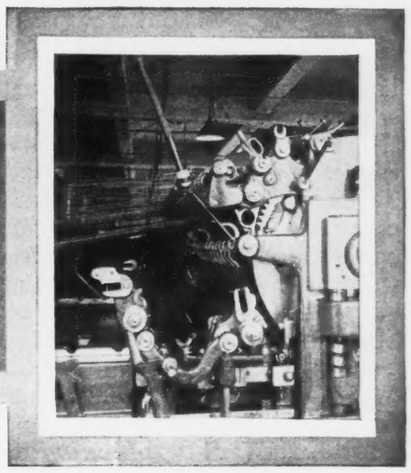
The radius of the crown of the head shall be $2\ 1/2D$.

When head is not necked, it shall be beveled not more than 40 degrees under the head.

MACHINERY'S Data Sheet No. 139, New Series, October, 1928



Ingenious Mechanical Movements



QUICK STOP MECHANISM FOR SPRING-WINDING MACHINE

By J. A. TAYLOR

A quick stop mechanism which has been used successfully on a machine for winding springs has an operating shaft *S* (see accompanying illustration) which withdraws idler pulley *L* and advances arm *G* on which pawl *H* is attached. This pawl pushes against a pin in essentric *E* and turns it, thus tightening brake-band *C* on brake-drum *F*. It will be seen, therefore, that as soon as the driving belt is slackened by withdrawing pulley *L*, the brake is applied. Arm *G* is supported by an extension which rests on collar *A*.

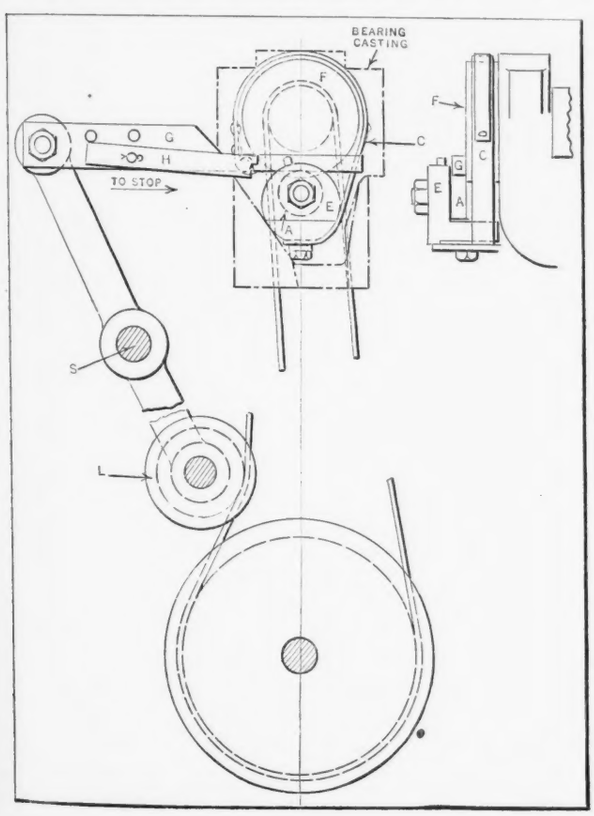
When the brake-band is adjusted to the proper tension, the pawl will tighten it and then slip over the pin, allowing the brake to release and leaving the spindle free after stopping it; or if desired, the adjustment can be such that the pawl will not slide over the pin, in which case the spindle is stopped and held stationary. The spindle speed is 7000 revolutions per minute and there is very little wear on the parts. The operating shaft *S* has a handle on one end, conveniently located for the operator, but this motion could, of course, be applied automatically if desired.

* * *

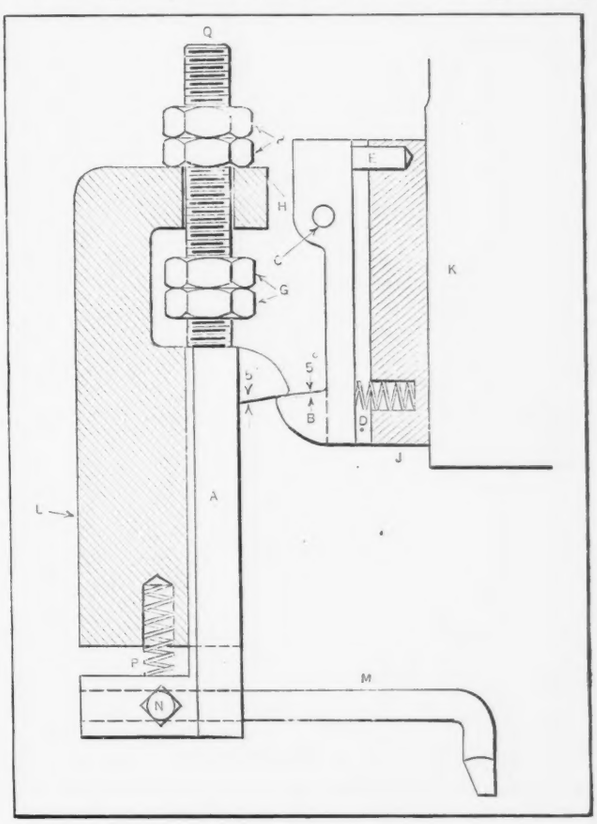
STOCK GAGE FOR POWER PRESSES

By F. MARTINDELL

In a large eastern plant where power presses are used, the stock gage is made part of the press equipment instead of part of the die, as is customary. The mechanical gage finger that has been developed embodies a very simple tripping device. In the diagram, the device is shown in its operating



Stop Mechanism which Slackens Driving Belt and Applies Brake



Stock Gage which is Part of the Press Equipment instead of Part of the Die

position on the back of a straight-side blanking press. A hook-block *A* slides in gibs in the cross-arm *L*, and carries on its lower end the stop-finger *M* secured by the set-screw *N*. The threaded stem *Q* of the slide extends through the stop-lug *H* and carries stop-nuts *F* and *G*.

The ram of the press *K* carries the trunnion block *J* in which swings the hook *B* on the cross-pin *C*. Hook *B* is pressed outward by the spring *D* until the upper end strikes the stop-pin *E*. The radius of the tips of the hooks is approximately 1/16 inch.

In operation, the action is as follows: With the sliding hook down, the stop-nuts *F* are against the top of lug *H*, and the tip of the finger *M* rests on the die. The ram *K* descends carrying *J* and *B* with it. The large radii of *A* and *B* engage, pressing *B* back against the spring *D* until *B* passes *A*. On the up stroke, the sloping surfaces of *A* and *B* engage and *B* lifts *A* until the stop-nuts *G* strike the under side of the lug *H*, which prevents further movement of *A*. The reaction between the sloping surfaces of *B* and *A* forces *B* and *A* apart, so that they unhook, allowing *A* to drop through the force of gravity and the action of spring *P*. On the next stroke of the press, the action is repeated.

It will be noted that the finger *M* moves with the punch after the stock has been blanked, but holds the stock stationary during the blanking. This one feature largely reduced the number of spoiled blanks caused by movement of the stock during blanking.

* * *

AUTOMATIC GRINDING FIXTURE

By D. R. HOLL, Engineering Department, Gardner Machine Co., Beloit, Wis.

The ends of connecting-rod caps are ground on a quantity basis by using a grinding machine equipped with the special rotary type of work-holding fixture illustrated in Fig. 1. The two faces and two sides of these caps are finished prior to the end-grinding operation.

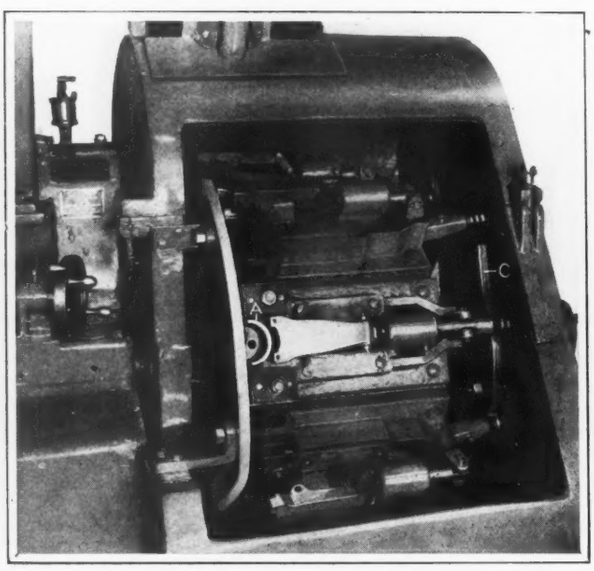


Fig. 1. Automatically Operated Fixture Used in Grinding Ends of Connecting-rod Caps

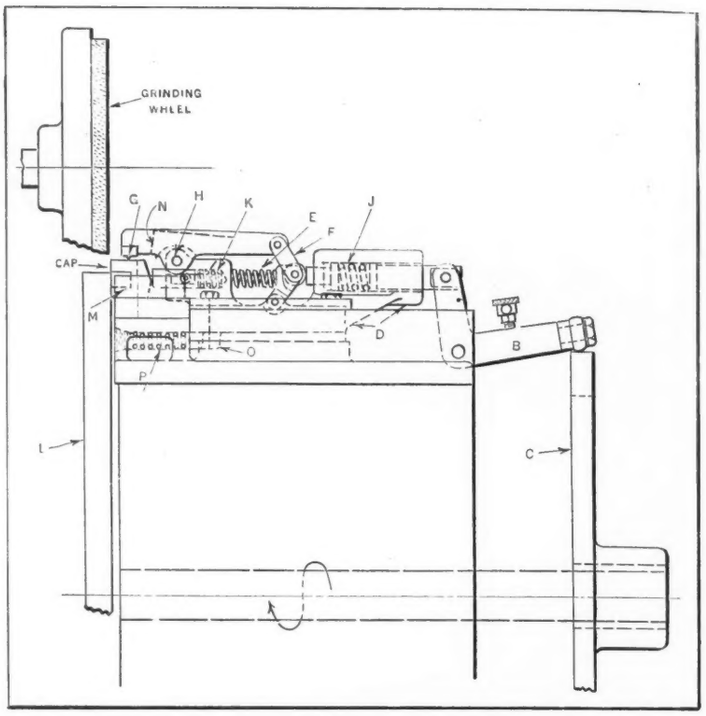


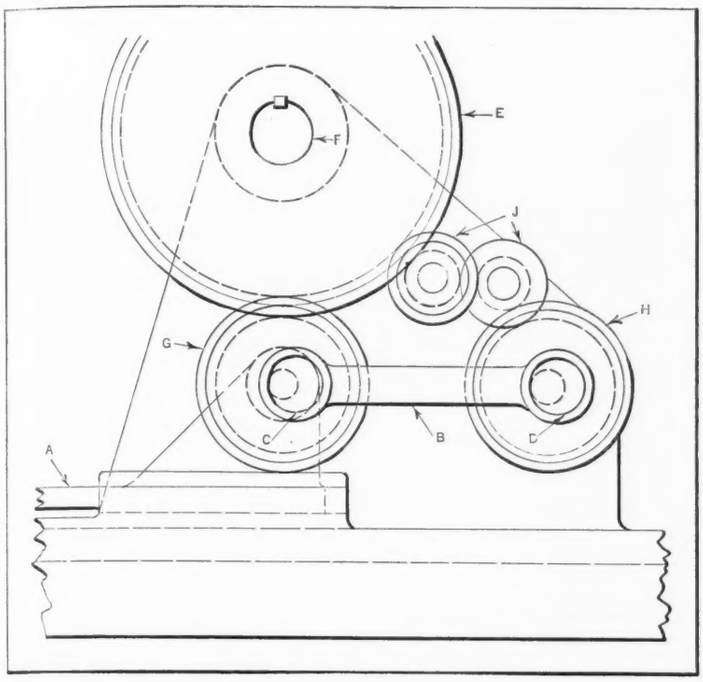
Fig. 2. One of the Clamping Mechanisms on Fixture Shown in Fig. 1

This fixture has eight work-holding positions, and as the fixture rotates, each successive cap is carried past the face of the grinding wheel. After the operator places a cap in position, as at *A*, it is automatically located and clamped as the fixture carries it around to the grinding position.

The clamping action is derived from a fixed cam *C*. The diagram, Fig. 2, shows one of the eight clamping mechanisms, which are located around an eight-sided drum. As the drum revolves, cam *C* raises lever *B*, which pushes slide *D* forward until it comes against a stop. The cam continues to raise lever *B*, which compresses spring *E* as the toggle *F* straightens, thus forcing downward on the cap two hardened edges *G* of the clamping lever, which is pivoted at *H*. Any further upward movement of lever *B* tends to increase the tension on spring *J*. The function of spring *K* and the plunger in front of it is to push the cap against aligning plate *L* before it is gripped by the clamp at *G*. The cap is also located between side blocks *M*.

After a cap has passed the grinding wheel, cam *C* allows lever *B* to drop, and then spring *E* forces the toggle *F* back, which releases the clamp. The dotted lines at *N* and *O* indicate the positions of the clamp and slide when the fixture is being loaded. The spring *P* pushes slide *D* back into the loading position, and the ground cap drops out by gravity as the drum carries it downward at the back of the machine, the cap passing through a chute.

In designing a fixture of this general type, spring *J* should be made stronger than all the other springs, plus the total amount of friction. Spring *E* should be strong enough to overcome spring *K* plus spring *P* plus friction. Spring *K* should be very light, and spring *P* just heavy enough to move slide *D* back to the loading position.



Mechanism for Alternately Increasing and Decreasing Movement of Slide

VARIABLE RECIPROCATING MOTION

By J. E. FENNO

A mechanism used on cotton fabric machinery for varying the traverse of rolls is designed to give a variable reciprocating motion to slide *A* (see illustration), which has a movement varying from zero up to the maximum of 1 inch with a gradual reduction back to zero. The slide is traversed through link *B*, and the variation in stroke is obtained by eccentrics *C* and *D*, the relative positions of which are changed, thus lengthening or shortening the effective length of link *B*.

The driving gear *E* is keyed to shaft *F* which receives its motion from the machine proper. Gear *E* meshes with gear *G* directly, and with gear *H* through two idlers *J*. Gears *G* and *H* turn freely on studs. The stud for gear *G* is fastened into the driven slide, and the stud for gear *H* into a bracket. The eccentrics are integral with their respective gears, and there is a variation in the eccentricity due to a difference of one tooth in the gears *G* and *H*. When the movement of one eccentric neutralizes that of the other, the driven slide remains stationary, and this movement gradually increases from zero up to the maximum as the relative positions of the two eccentrics change. This traversing movement causes a change in the center-to-center distance between gears *F* and *G*, but since involute teeth are used, this variation does not interfere with the tooth action.

* * *

SAFETY DEVICE FOR KICK PRESS

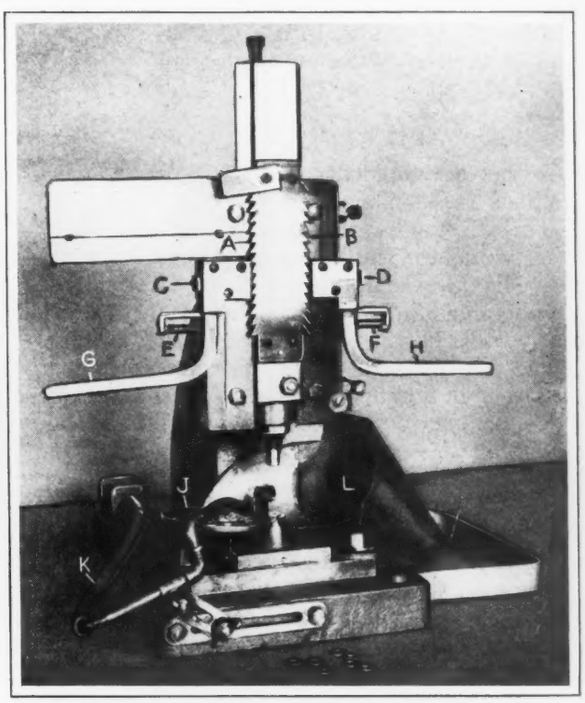
By P. J. EDMONDS

In the metal stamping department of the Westinghouse Electric & Mfg. Co. at East Pittsburgh, Pa., foot-operated presses are equipped with a safety device to prevent the operator's fingers from being crushed between the punch and die. A double rack having teeth at *A* and *B* is fastened to the ram of the press. Right- and left-hand stops or pawls *C* and *D* are held in engagement with their respective racks by springs *E* and *F*, the inner ends of which are attached to handles *G* and *H*. When these handles are pulled down, the locking pawls *C* and *D* are withdrawn; hence, to operate the press, it is necessary for the operator to use both hands in moving handles *G* and *H* downward. As soon as the locking pawls have been released in this manner, the foot-pedal is "kicked" to perform the operation.

A small shelf *J* holds a number of pieces on which the operation is to be performed. After "nesting" each piece in the die by using the fingers, the locking pawls are released and the ram descends. When the ram returns, the foot-pedal opens an air valve for an instant, which permits a sufficient amount of air to pass through pipe *K* to blow the piece off the die and through funnel *L* into a pan. About twenty foot-operated presses are equipped with this safety device, and only three lost-time accidents have occurred during the last five years, none of which was serious.

* * *

About three million non-metallic gears are now used annually in the automobile industry alone, against less than one million, three years ago, according to a statement made by T. C. Roantree in a paper presented before the American Gear Manufacturers' Association. Mr. Roantree pointed out that the growing use of the non-metallic gear in the automobile industry insures that this type of gear will gain favor in all branches of industry.



The Handles at Right and Left Must be Pressed Down before Press can be Operated

Current Editorial Comment

In the Machine-building and Kindred Industries

THE TOOL ENGINEER'S FUNCTIONS

The heading illustration of the article on page 81 in this number of MACHINERY, shows the latest model of a well-known automobile placed side by side with the first car of the same make built twenty-seven years ago. Few of those old enough to remember the advent of automobiles can conceive that they ever resembled so closely small horse-drawn carriages. In few other industrial fields have so many and so radical changes been made during the past quarter of a century.

In this remarkable advance the tool engineer has played an important part. The automobile designer is justly entitled to credit, but after his problem was solved, to use the words of the author of the article referred to, "the tool engineer's job was to take the ideal of the automotive designing engineer and convert it into a practicability." The production problem then had to be solved.

It is the tool engineer's job to devise the ways and means to produce every part of the automobile quickly, accurately and economically. He must design and supervise the building of special machinery and shop equipment, originate means for handling parts and materials, and plan the sequence of operations. He must buy machine tools, accessories and small tools, and thousands of jigs, fixtures and special tools must be designed for the production of a single automobile model.

The tool engineer in the automobile plant produces his results in a quiet, efficient way. The outside world knows little about him, but to his ability and ingenuity is due, in a great measure, the success of the American automobile industry.

* * *

THE WORK OF THE DEMONSTRATOR

In the development of machine tools and shop methods the demonstrator of shop equipment has become an important link between the builder and user of tools. The demonstrator is the representative of the machine tool builder. His personality may help or hinder the progress of his firm, and in many ways it will be judged by his likeability.

The first duty of a demonstrator is to instruct the foreman and operators in the use and care of a new machine, to show them how to obtain the best results in accuracy and production, and how to maintain them. Always he should try to create good will for his company, which he can do by placing all his mechanical knowledge in regard to the operation of his machine at the disposal of the customer, and of course by making plain all the points that they want information upon. Naturally, a part of his work will be an honest effort to show the customer that his machine is the best on the market for the work it is designed to do.

The demonstrator also can serve his firm by collecting data on the productive capacity and accuracy of the machine when used on the customer's work. An accumulation of such data will help his employer to estimate the value of the machine under actual operating conditions. The demonstrator also is often able to suggest improvements in design.

* * *

TOLERANCES SHOULD BE PRACTICABLE

When too close tolerances are specified on a drawing, the effect is much the same as when a law is enacted that is difficult or impossible to enforce. If the production departments and the inspectors find it difficult to produce work within the close tolerances specified, without curtailing production, and if the parts to be made will serve their purpose even if the close tolerances are not carefully observed, the tendency is to ignore the limits given on the drawing—at least to some extent. This policy is undesirable, because it gradually develops contempt for the instructions on drawings, which really should be considered "the law" of the shop.

When it is found that drawings specify tolerances which seem impracticable, they should be changed through the cooperation of the engineering and shop departments. If the former department has specified too close tolerances, surely they should be corrected, because only in that way can it hold the respect of the shop for the instructions given on drawings in general. If the drawings and specifications issued by the engineering department are considered merely as general guides, rather than as definite instructions to the shop, there will be endless confusion.

* * *

INSTALLING MACHINES ON TRIAL

The objections to this practice have been referred to already in MACHINERY, but as it is common with some purchasers, it may well be mentioned again.

In our opinion, the only occasion for a trial installation of a machine tool is when it is of entirely new design and has not been previously tried out in production work. In such cases, when the customer aids the builder of the machine by suggesting improvements, such trials are of advantage to both; but when a machine has been on the market long enough to fairly demonstrate its success, we can see no reason why it should be sold on trial.

The privilege of trying out and returning machines has often been abused. In one instance a customer returned a grinding machine after it had been on trial for five months, stating that it did not meet his requirements; and when returning it, asked that another size be substituted—also on approval—which the machine tool builder naturally declined to do.

Usually, it is easy for an experienced mechanic to determine whether a machine that has been successful in other plants on similar work can be used advantageously in his own shop.

Quality—the Keynote of Present-day Automobile Production

By WALTER P. CHRYSLER, Chairman of the Board, Chrysler Corporation

ALL new inventions that are ultimately to become essential factors in human life and in the advancement of civilization must go through three principal stages of development.

The first is the inventive and experimental stage. Twenty-five years ago the automobile, as we know it today, existed mainly in the minds and in the hopes of inventors and designers. In the early days of the present century, the budding automobile industry was experimenting with an almost endless variety of self-propelled vehicles. Few of those engaged in this work could properly be called automobile engineers, and there was no agreement between engineers even on the general principles involved, far less on the details.

This was the period when those who designed and built cars hoped that they would be able to produce automobiles that would run. Naturally, the first experimental cars were costly, and there was little stability in the automobile industry. If the automobile was to become an essential factor in modern life, however, a stable industry had to be built up to produce cars.

Walter P. Chrysler, Chairman of the Board, Chrysler Corporation

The second phase in the development of the automobile industry was the production of more nearly standardized types of cars in such volume that they came economically within the reach of the mass of the people. To Henry Ford must go the credit for having seen the vision of quantity production and low prices. He set the pace through the long years of the second phase—the period of low-cost cars.

The culmination of this period was the great quantity production era. Some thought then that the ultimate status of the automobile industry had been attained. Quantity became the keynote of the automobile industry. It is logical that quantity production should be followed by an era of ever lowering prices. In spite of the interruption of the war period, the downward trend of prices continued.

Quality Production—The Third Phase in the Automobile Industry

Now we are at the beginning of the third phase—an inevitable reaction from quantity production and low prices, which manifests itself in a demand for quality. The universality of that trend affecting all essential products suggests that it is perhaps more sociological than economic. When any article that is universally needed becomes cheap enough for practically everyone to possess it, the demand for higher quality, for better style, and for greater luxury, quickly follows.

Since 1924 the demand for quality has become universal. It has changed the character of automobiles in a most radical way. It has remodeled factories, and not a car that I know has escaped the necessity of conforming to a new conception on the part of the public of what constitutes value in an automobile today. I can offer no stronger evidence of this fact than the new Ford car. Unlike many of his too hasty critics, I do not agree that Mr. Ford failed to recognize the newer trend. His latest product is his recognition of the public demand for modern luxury, improved performance, and higher quality.

Hence, we have now definitely arrived at the third and most permanent phase of any industry. The problem is now to produce a quality car on the most economical basis. Quality is no longer the exclusive prerequisite of the large and high-priced car. Miracles of engineering and manufacturing have been accomplished in the last five years, which have demonstrated the practicability of building the finest quality cars in large quantities, thereby giving greater values than ever before.

It is my judgment that automobile manufacturers will never again be able to make even the slightest sacrifice of quality for the sake of price. Quality in the lowest-priced as well as in the highest-priced cars is here to stay.

The Traffic Conditions of Today Demand the Highest Quality in Cars

We must have power and a capacity for speed, which is inherent in power, to cope with modern traffic conditions. To endure the constant strain of high speeds, motors and chassis must be built with higher factors of safety and to closer limits than have ever been known before. Long life in an automobile must no longer be made a matter of the driver's consideration for his car. Long life is an essential element of the manufacturer's program of design and construction.

With the faster movement of traffic we must also have cars that are comfortable at high speeds, that can take turns without dizzying side-sway, and that will pass over ordinary road inequalities without uncomfortable jolting. These are qualities to be found only in well designed and well built cars.

On account of the greater volume of traffic, moving at a higher speed, cars must also be under constant control. The public will no longer drive or ride in cars that are not equipped with good four-wheel brakes, or in cars that are hard to steer, that have stiff clutches, in which the gears shift with difficulty, or that cannot be decelerated even more rapidly than they pick up speed.

It is an established fact that, given a rightly built car with a proper factor of safety in its control, the faster movement of traffic today is safer than the slower speeds of ten years ago.

When We Demand Quality, We Must be Prepared to Pay its Price

There is no one who does not recognize the essential need for quality in an automobile, but it is obvious that high quality will add to the production cost, and that is precisely where we find ourselves today. We are achieving the highest quality on a quantity production basis, and many fine cars are now lower in price than they have ever been. In this phase of manufacture, the public must recognize that prices cannot indefinitely continue in their downward trend. Quality in any product is essentially an element of cost. Presumably the higher the cost, the greater the quality. While this is not invariably true, it is nevertheless the general basis upon which this great industry must be built.

In view of this, there are economic limits below which quality would be sacrificed if a certain price had to be met. I believe that automobiles are now at the approximate ebb tide of low prices, if we are to see quality sustained. I believe that as a commodity, the automobile represents the maximum dollar value in the country today, and I further believe that any price changes in the automobile industry in the future are more likely to be upward than downward.

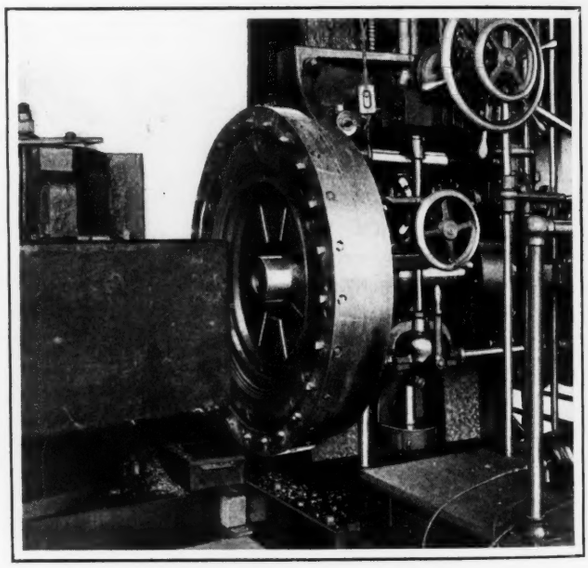
In the meanwhile, we are moving toward stabilization of this great industry. The automobile is now as much a part of the warp and woof of our entire life as furniture or clothing, and as in all practical things of life good quality is the very essence of utility and value, so it is in automobiles; also, as with all other necessities, the American public is willing to pay whatever quality costs, as long as the public feels that it is getting the maximum value for its dollar.

Summarizing, therefore, I believe that quality is the keynote of success in the automobile industry today. The ability to give quality and value will measure the standing of the cars of the future. Individual transportation has been developed to a point where it is certain that it will always be with us. Individual transportation has actually come to be regarded as one of the primary necessities of life, and the industry producing it is now considered as indispensable as the industries producing food, clothing, and shelter.

* * *

FACING LARGE STEEL CASTINGS

A cutter-head 46 inches in diameter at the cutting points, having twenty-two inserted tools, is employed on a horizontal boring machine at the Watervliet Arsenal, Watervliet, N. Y., for facing operations on certain large steel castings. The

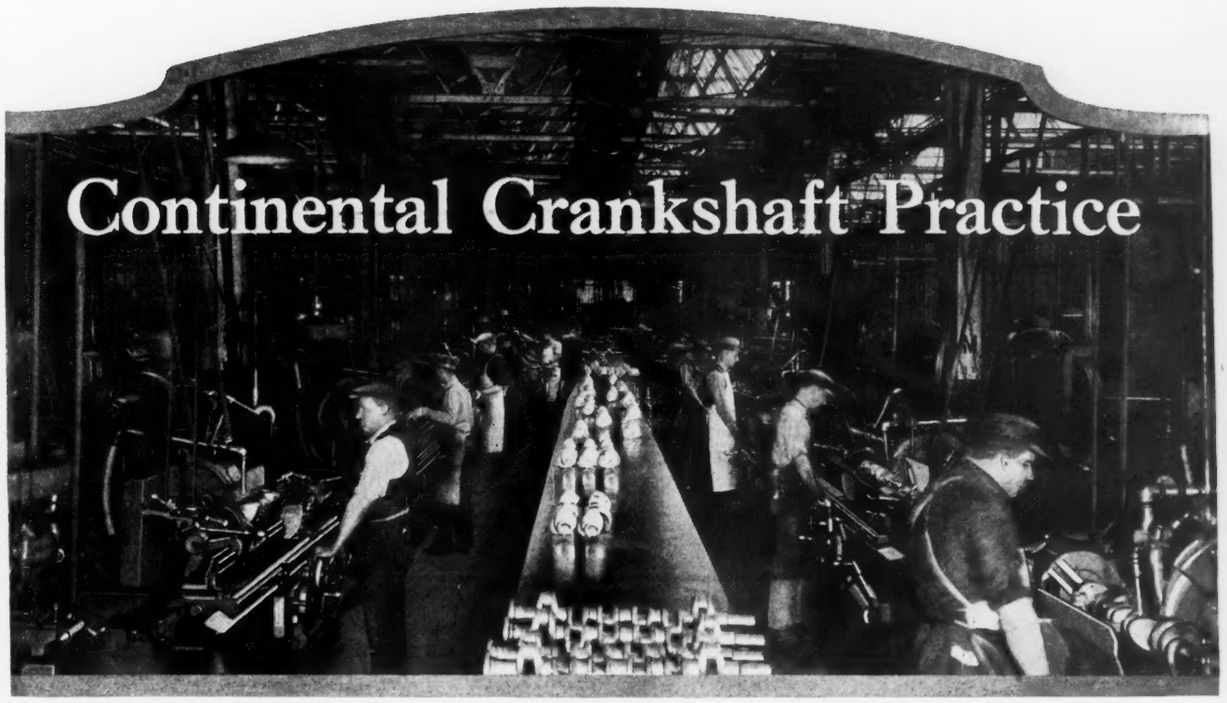


Employing a Large Cutter-head with Twenty-two Tools for Facing Operations on Large Steel Castings

illustration shows such an operation being performed on one side of the recoil band for a 16-inch gun. In this operation, the column of the machine is moved along its bed to carry the revolving cutter-head straight across the work. When one side of the casting has been machined, the circular work-table is indexed 180 degrees to bring the second side into position.

The inserted tools are made of 1 inch diameter high-speed steel, and have the ends ground to a V-shape. They are held by set-screws in holes in the cutter-head. The latter is mounted on the regular faceplate of the machine. Roughing cuts 1/4 inch deep are taken with this cutter-head at a feed of 3/16 inch per revolution. The cutting speed is approximately 20 feet per minute. If the amount of stock to be removed permitted, roughing cuts as deep as 5/8 or 3/4 inch could be taken. The feed would, of course, be reduced correspondingly. Finishing cuts 1/16 inch deep are taken with a feed of 3/8 inch per revolution of the cutter-head and with a cutting speed of 20 feet per minute.

Castings of the type illustrated weigh about 57,000 pounds, and the surfaces machined are approximately 120 inches long by 25 to 45 inches wide.



Continental Crankshaft Practice

Methods Recently Adopted for Making the Crankshaft of a Well-known Six-cylinder Automobile

By CHARLES O. HERB

AUTOMOBILES today are better in quality and cheaper in price than ever before. This is primarily the result of the development of machine tools and their accessories to meet the particular needs of the automotive industry. Production executives have always been ready to adopt new machines and methods when shown that greater production or higher quality of the product could be obtained by their use. They have also cooperated in the development of new and improved methods by making practical suggestions to machine tool builders derived from experience. It is small wonder then that the methods now used in machining almost any automobile part differ substantially from the practice of a few years ago.

When the Continental Motors Corporation, Detroit, Mich., contracted some time ago to build the six-cylinder engine for a new automobile, since placed on the market, the engineers of that company had the opportunity of installing up-to-date machines for practically every operation on that job. Machines were arranged in lines believed to give the most efficient sequence of operations. One of the line-ups in which special pride is taken is that employed for machining the crankshaft. The methods and machines used for this purpose are described in this article.

The crankshafts are forged from S.A.E. No. 1045 steel, under a heavy steam hammer. After being forged, they are placed for 2 1/2 hours in an oil-fired furnace, held at a temperature of 1575 degrees F., and hardened by quenching in water. Tempering is the next step, and this consists of reheating the crankshafts to 1100 degrees F., holding them at this temperature for 2 1/2 hours and slowly cooling.

At the end of the heat-treatment, the forgings must have a minimum tensile strength of 100,000 pounds per square inch; a minimum elastic limit of 65,000 pounds per square inch; and a scleroscope hardness of from 38 to 42, or a Brinell hardness of from 225 to 248. Each forging is thoroughly inspected to insure that it is free from hard spots, scale, folds, welds, or other imperfections. Scale obtained in the heat-treating is removed in a pickling operation. The crankshafts are also sand-blasted, straightened, and centered before they are sent to the machining department.

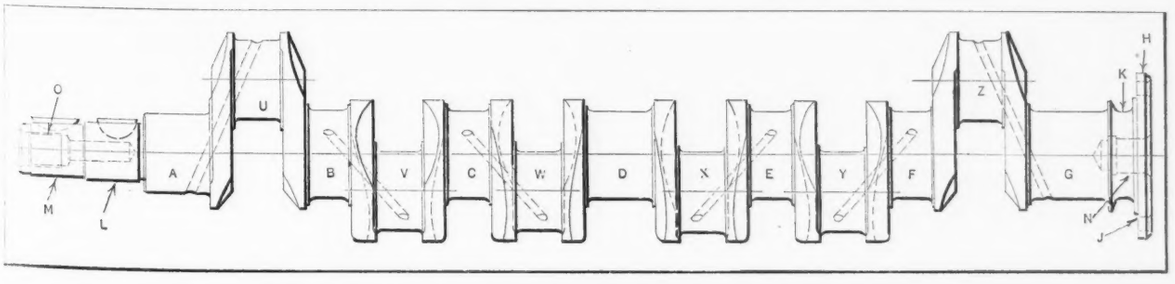


Fig. 1. Seven-bearing Crankshaft for a Six-cylinder Automobile

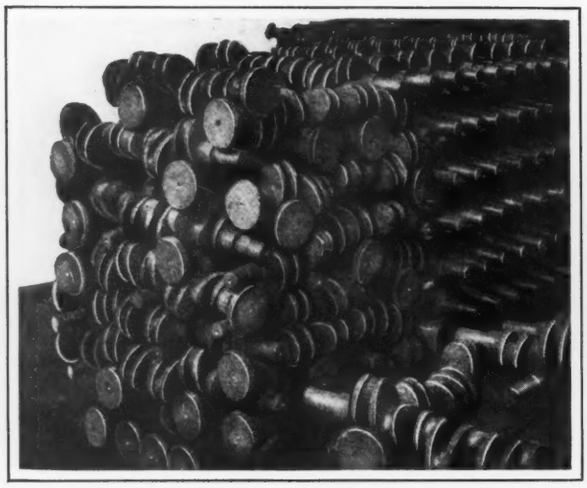


Fig. 2. Rough Crankshaft Forgings Ready for Transportation to the Machining Department

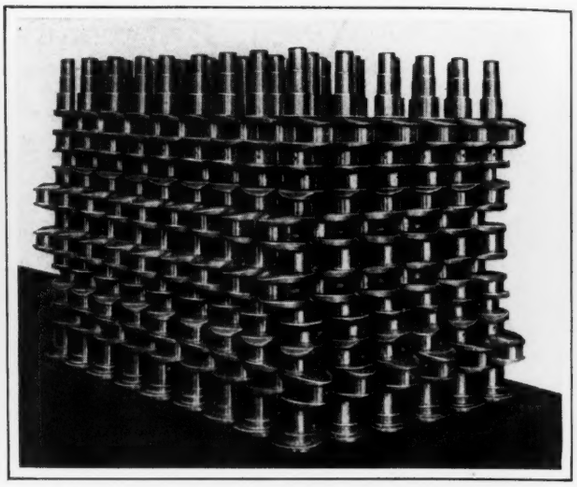


Fig. 5. Stack of Crankshafts Finished All Over, Ready for Service

Accuracy Required of the Crankshafts

Forty-six operations are performed on the crankshafts from the time they reach the shop in the rough-forged state seen in Fig. 2 until they leave the machines in the highly finished condition illustrated in Fig. 5. When the crankshaft is finished, all seven bearings must be straight in line within plus or minus 0.002 inch, as determined by indicator readings. Each crankpin must be parallel with the main bearings within plus or minus 0.001 inch, and the 120-degree location of the crankpins must be maintained within plus or minus 0.010 inch in relation to the No. 1 crankpin. Crankpins or main bearings cannot be out of round more than 0.0005 inch, and the spacing from any crankpin to the front bearing must be true to the nominal dimension within plus or minus 1/64 inch. The limits on each bearing or crankpin diameter are plus or minus 0.0005 inch. The crankshaft is finished all over and accurately balanced.

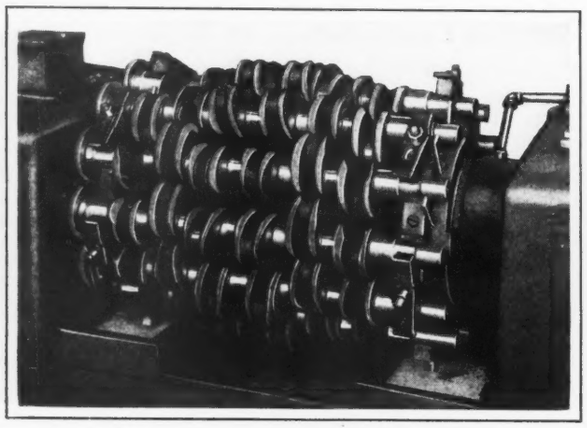


Fig. 3. Milling Crankshafts to Length

The machines employed in taking the various cuts on the crankshaft are arranged on both sides of two aisles. Long tables with sheet-metal tops extend the entire length of the aisles, as shown in the heading illustration, to facilitate passing the work from machine to machine. The crankshaft moves not only lengthwise along the tables but also back and forth between the machines on each side. The machines are tooled up for producing 300 crankshafts per ten-hour day. Many of them are automatically controlled, so that one man can operate several machines.

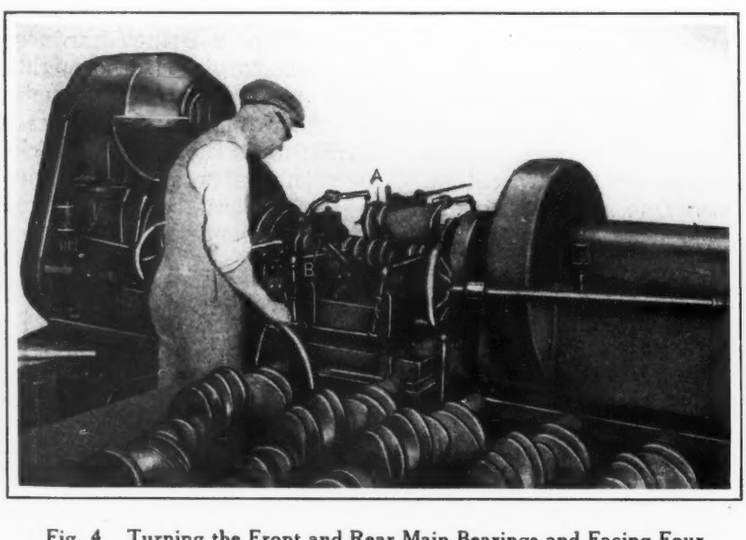


Fig. 4. Turning the Front and Rear Main Bearings and Facing Four Crank Cheeks

Turning the Bearings and Facing the Crank-arms

The first machining operation on the crankshaft consists of rough-turning the central main bearing *D*, Fig. 1, in a lathe, to permit the use of a steady-rest on this bearing in the next operation. The second operation consists of rough-turning the front and rear main bearings *A* and *G*, as well as facing the crank-arm cheeks adjacent to these bearings and to bearing *D*. This operation is performed on the Wickes semi-automatic lathe illustrated in Fig. 4, which is provided with three tool-holders on the front cross-slide and two tool-holders on the rear cross-slide.

The tools of the middle tool-holder on the front slide face the crank-arms adjacent to the middle bearing, while the tools of the two end tool-holders on

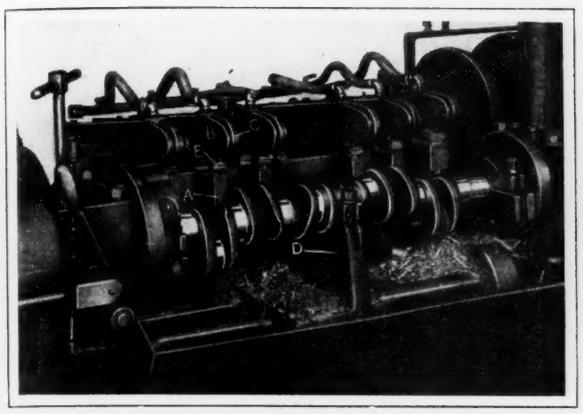


Fig. 6. Finish-turning Six Bearings at One Time with Cam-operated Tools

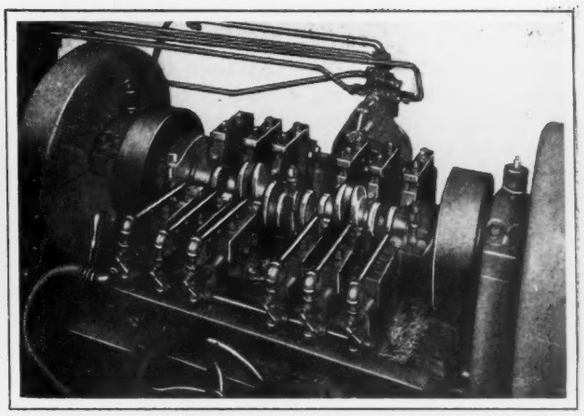


Fig. 7. Another Machine Used for the Same Operation as that Shown in Fig. 6

the front slide turn the main bearings *A* and *G*, Fig. 1. A single wide-faced tool turns each of these bearings to the full width without longitudinal movement of the carriage. The tools on the rear slides face the crank-arm cheeks adjacent to the bearings turned by the opposite tools on the front slide. After the operator starts the machine, it functions automatically until the cuts have been completed, and then stops.

The steadyrest used in this operation consists of two roller disks, one of which can be clearly seen at *A*, Fig. 4. Split chucks are employed, which have corrugated jaws for gripping the work surfaces. The crankshaft is located lengthwise on the machine before the chucks are closed, by means of the hinged gage *B*, which registers on the previously finished middle bearing. It can be swung out of the way, as shown, after the chucks are clamped on the work. A light overhead hoist is provided for lifting the crankshafts into and out of this machine. Similar hoists are furnished for many other machines in the department.

The crankshaft is next passed to another Wickes semi-automatic lathe in which the flywheel flange *H*, Fig. 1, is turned and straddle-faced, and the oil-thrower groove *K* and bolt circle *J* are formed. The work is well supported by the headstock chuck, which extends to the center main bearing *D*. The gear end of the crankshaft is supported by the tailstock center. The facing cuts are taken by two tools on the front slide of this machine, while tools on the rear slide take the turning and forming cuts. In this operation, and in the remaining operations performed with the same type of machine, the crankshaft is located from the front main bearing *A*.

The four intermediate bearings *B*, *C*, *E*, and *F*, are next turned, and their adjacent crank-arm cheeks faced, in another Wickes lathe. The front slide of this machine is equipped with four tool-holders having wide-faced tools for turning the entire length of the bearings without longitudinal movement. Eight tools on four holders of the rear slide do the facing of the cheeks. A steadyrest supports the middle main bearing.

The crankshaft is then passed to another machine of the same type, equipped with a wide-faced tool on the front slide for turning gear fit *L* and facing the front shoulder of main bearing *A*. A tool on the rear slide simultaneously turns the fan pulley fit *M*.

In taking these various rough-turning cuts, about

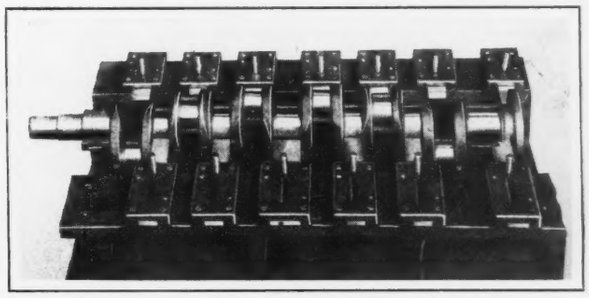


Fig. 8. Inspection Fixture Employed for Checking the Spacing of All Turned Bearings and Crankpins

1/8 inch of stock is removed on each side of the crankshaft and approximately 0.050 inch of stock is left on the diameters for subsequent removal.

Milling to Length

Each crankshaft is milled to length in the Newton continuous drum-type machine illustrated in Fig. 3, on which twelve crankshafts can be loaded at one

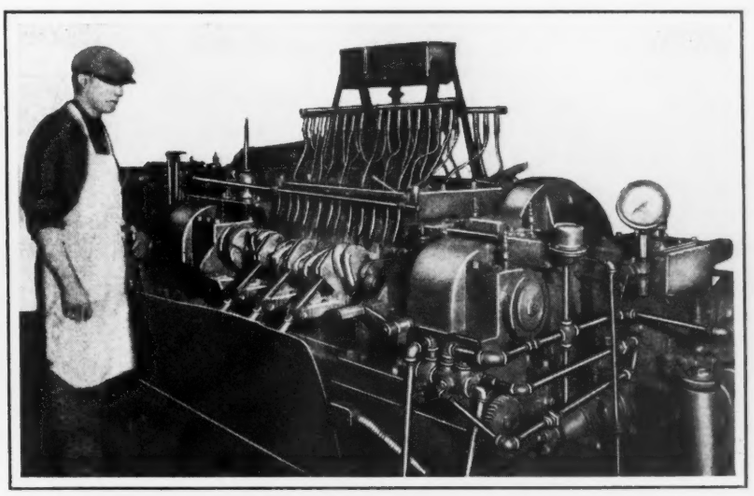


Fig. 9. General View of Machine Employed in Turning Contours of Crank-arms

time. As the drum revolves, it carries the crankshafts past two face milling cutters on the rear of the machine which mill the face of the flywheel flange and the gear end. Locating blocks are spaced around the center of the drum, on which the middle main bearing of the crankshafts is seated to insure correct endwise location. The crankshafts are also supported by these blocks, in addition to V-blocks, in which each end of the crankshafts is seated. Clamps are applied as shown to hold the crankshafts securely for the operation.

At the end of the milling operation, the crankshaft is passed to a double-head centering machine, which recenters the two ends in relation to the rough-turned bearings. Then, if straightening is necessary, this operation is performed on a 20-ton "Flexible" press, after which the central main bearing *D*, Fig. 1, is rough-ground.

Finish-turning the Crankshaft Bearings

Finish-turning cuts are taken simultaneously on all bearings, with the exception of the middle main bearing, either in the Melling crank lathe shown in Fig. 6 or in the Wickes semi-automatic lathe illustrated in Fig. 7. This operation eliminates the

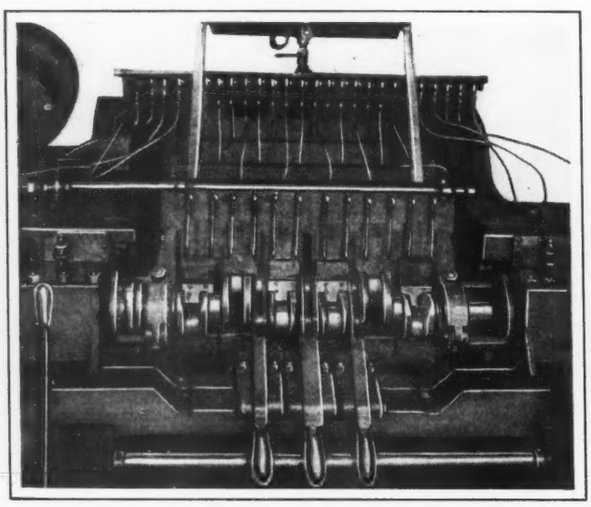


Fig. 10. Close-up View of the Operation Illustrated in Fig. 9, Showing the Tool-blocks and Steadyrests

necessity of rough-grinding the bearings, approximately 0.025 inch of stock being removed, which leaves about 0.025 inch of stock to be taken off later in the finish-grinding operation.

In the Melling lathe, the cuts are taken by wide-faced tools such as shown at *E*, Fig. 6, which are carried in large tool-holders *A*. These tool-holders are mounted on a shaft having eccentrics which serve to feed the tools into the work. An intermediate shaft carries two cams, which automatically lower the tools to the work for the operation and raise them when it has been completed. While the tools are cutting, rollers *C* in brackets *B* bear on the surfaces being machined and act to steady the tools. Each end of the crankshaft is held in a chuck, and the middle main bearing is supported by steadyrest *D*. Coolant is supplied freely to the tools, as in practically all other operations.

On the Wickes lathe shown in Fig. 7, six wide-faced tools on the front slide turn the bearings to the desired diameter, while cutters in the six tool-

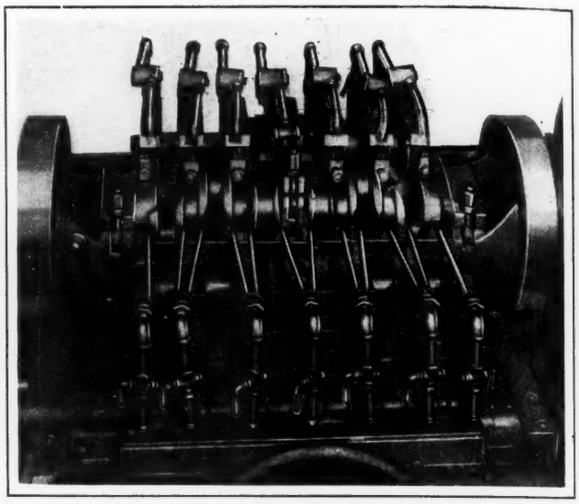


Fig. 11. Simultaneously Rough- and Finish-chamfering All Crank-arm Cheeks Adjacent to the Bearings

holders of the rear slide, finish-face and fillet the bearing shoulders. This machine is operated automatically by Oilgear hydraulic equipment, as are several others in the line-up.

Turning the Crankpins

The six crankpins are turned and the adjacent cheeks of the crank-arms faced in three operations performed in Wickes semi-automatic lathes. In the first of these operations, cuts are taken on pins *U* and *Z*, Fig. 1, and their crank-arms; in the second operation, on pins *V* and *Y* and their crank-arms; and in the third operation, on pins *W* and *X* and their crank-arms. Long pot chucks are employed in the second and third operations to support the work close to the tools. In all three operations, the work is held off center, so as to make it revolve about the axis of the two crankpins being turned. Tools similar to those used in turning the bearings and in facing the adjacent crank-arm cheeks are employed in these operations. The crankpin bearings are turned to within about 0.050 inch of the finished size, as no finish-turning cuts are taken on them.

At the end of the turning and facing operations on the crankpins and the crank-arm cheeks, the crankshaft is passed to a second 20-ton "Flexible" press for straightening. Various types of indicators

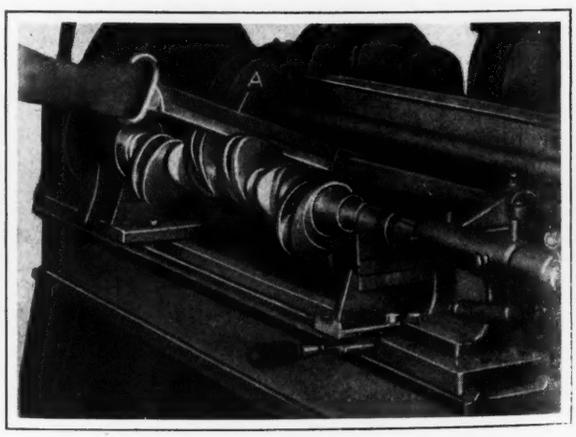


Fig. 12. A Simple Burr-removing Operation which has Proved to be a Great Time-saver

are employed to determine when the crankshaft is true. The inspection fixture illustrated in Fig. 8 is also employed at this point of the manufacturing process to determine whether or not the line bearings and crankpins are properly positioned. For this inspection, the crankshaft is laid in the fixture with the front and back main bearings *A* and *G*, Fig. 1, well supported. Six gage-blocks, similar to that seen at *A*, Fig. 8, are next pushed into contact with the middle main bearing, the four intermediate bearings, and the oil-thrower groove. Then, as the crankshaft is revolved, similar gage-blocks are pulled forward against the various crankpins, the flywheel flange, and the oil-thrower groove.

Location of the bearings, crankpins, etc., as well as the diameters of the various surfaces, can be quickly determined by this device. The inspection is not performed on every crankshaft, but it is done frequently to guard against the necessity of later discarding work improperly machined in the early stages of manufacture.

Finishing the Contour of the Crank-arms

After six holes have been drilled in the flywheel flange, the crankshaft reaches the Melling contour

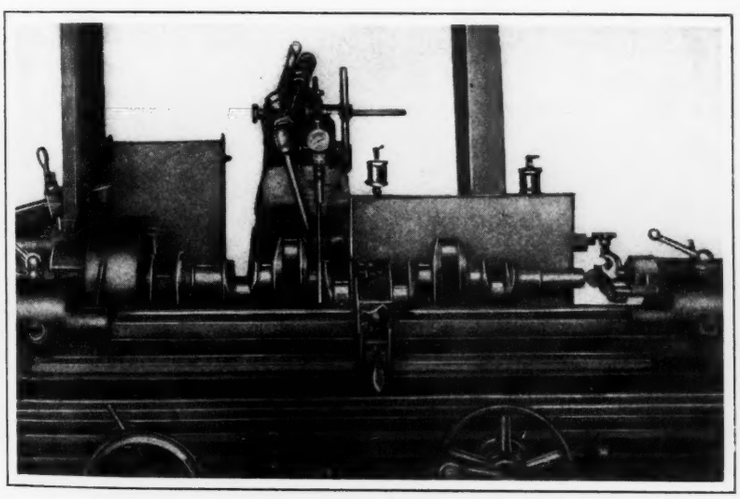


Fig. 13. Finish-grinding Operation on the Intermediate Bearings

lathe shown in Figs. 9 and 10, where the crank-arm edges or contours are turned. This machine also is automatically operated by means of Oilgear hydraulic equipment. The tools are held on six vertical blocks, which are hinged to permit them to be swung back and forth by cams, so that the tools will follow the contour of the crank-arms as the work is revolved. Each tool-block carries two cutters for machining the two crank-arms of one crankpin. The crankshaft is held on a long slide which has a slight longitudinal motion during the operation to feed the work past the tools. Three steadyrests are provided for the middle bearings, the upper halves of these steadyrests being raised and lowered by means of handles.

Chamfering and Filing the Crank-arms

All crank-arm cheeks are chamfered in Wickes semi-automatic lathes. Three separate operations are required for chamfering the cheeks adjacent to the crankpins, while all cheeks adjacent to the bearings are chamfered at one time. In chamfering the

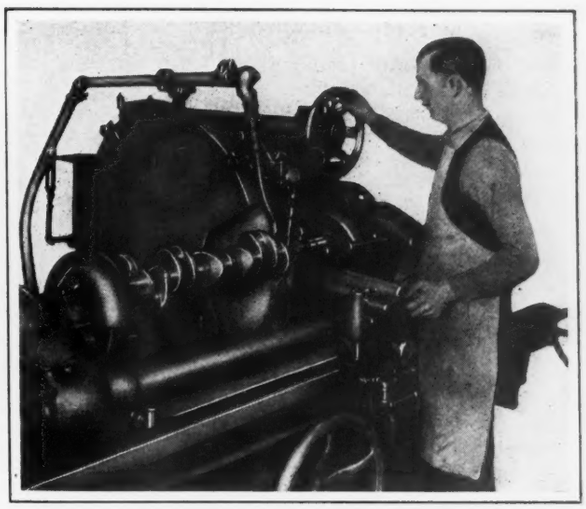


Fig. 14. Grinding All Six Crankpins at One Setting of the Work

crankpin cheeks, four tools held in two holders on the front slide and four tools in two holders on the rear slide take roughing and finishing cuts on the four cheeks. The operation on the bearing cheeks is illustrated in Fig. 11. There are seven holders on the front slide, with twelve tools for taking roughing cuts on the crank-arms, and a similar number of holders with the same number of tools on the rear slide, for finish-chamfering the same surfaces.

Next, another straightening operation is performed on the crankshaft, when necessary, after which the crankshaft is passed to the special stand illustrated in Fig. 12, which is equipped with a holder *A* on which files are mounted for removing burrs from all the edges of the crank-arms. The holder can be conveniently slid along the crankshaft by means of the bar at the rear. It is provided with files on an inner vee surface, as well as on the outside angular surfaces. With this equipment, burrs can be simultaneously removed from one edge of two different crank-arms. This device has proved to be a great time-saver.

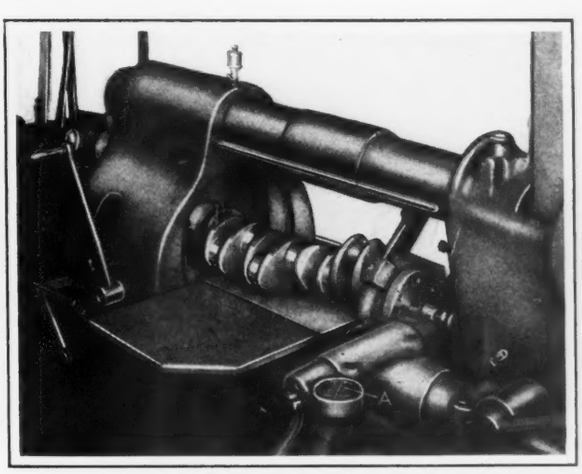


Fig. 15. Grinding a Small Hole in the Flywheel End

Rough-grinding the Crankpins and Drilling the Oil-holes

All crankpins are rough-ground on a Landis crankpin grinder to within from 0.015 to 0.020 inch of the finished size. Then the oil-holes, which extend through the crank-arms from each bearing to one of the adjacent crankpins, as seen in Fig. 1, are drilled under three special Leland-Gifford drilling machines of the construction shown in Fig. 16. These holes are 1/4 inch in diameter and about 5 inches long. In each machine, the crankpins in which the holes are drilled are seated in V-blocks to locate the work correctly for the operation. Clamps hold the work securely in position.

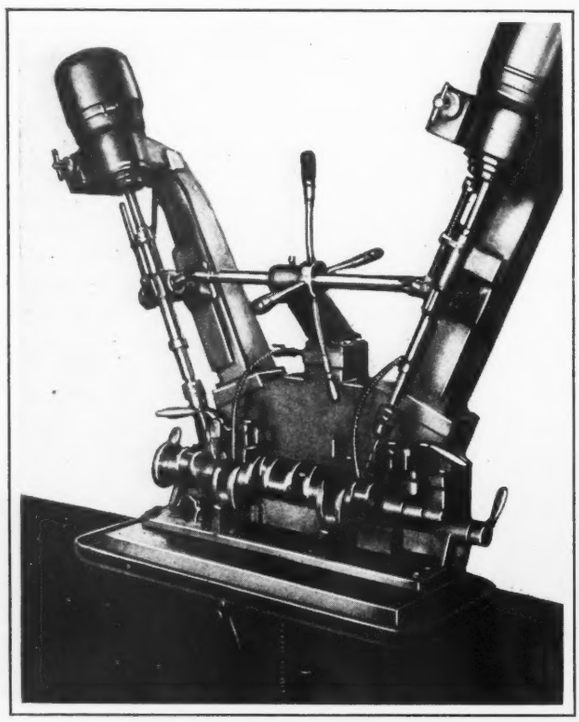


Fig. 16. Special Drilling Machine Employed for Drilling the Oil-holes

The oil-holes are next countersunk by employing an air drill, after which the crankshaft reaches another 20-ton "Flexible" press and is straightened as required, preliminary to the finish-grinding operations.

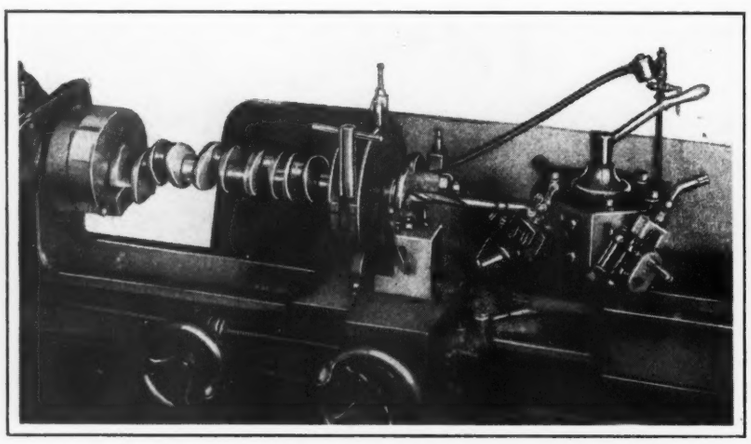


Fig. 17. Turret Lathe Operation on the Flywheel End of the Crankshaft

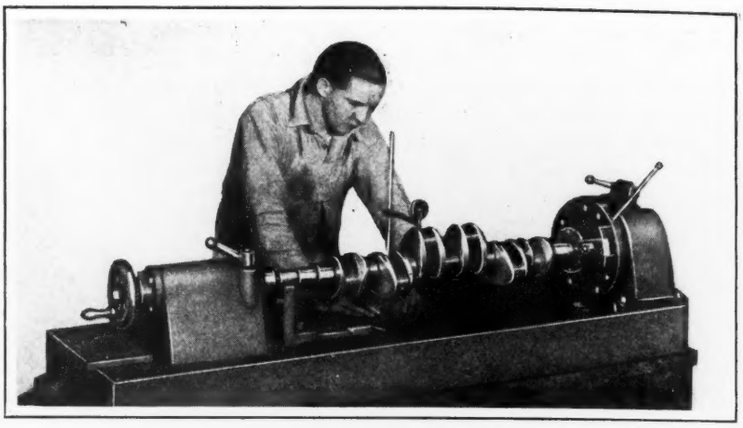


Fig. 18. Checking the Throw of the Crankpins in a Special Fixture

Finish-grinding the Bearings and Pins

All finish-grinding operations on the bearings are performed in Norton machines. Each machine is equipped with a Pratt grinding gage, such as seen in Fig. 13, which has contact points that are slipped over the surface being ground. The grinding wheel is merely fed toward the revolving work until the gage indicator reaches zero. The first finish-grinding operation is performed on the center main bearing, so that in subsequent operations, the crankshaft can be accurately located from this bearing.

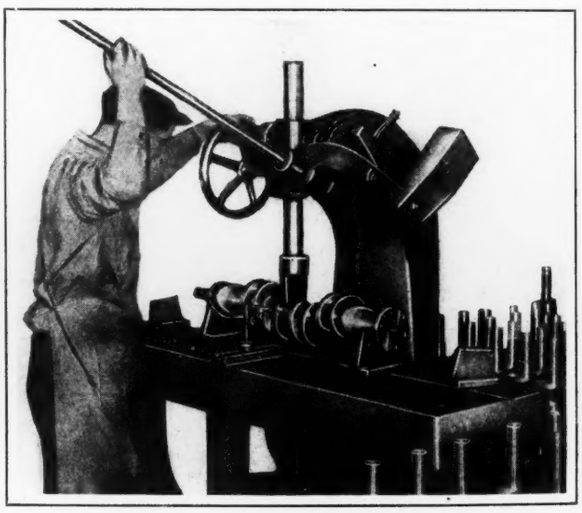


Fig. 19. Final Straightening Operation in a Hand-operated Arbor Press

The second operation, which is illustrated in Fig. 13, consists of grinding the four intermediate bearings. It will be seen that the crankshaft ends are held on centers, while the middle main bearing is supported by a steadyrest. In the third operation, the front bearing *A*, Fig. 1, and gear fit *L* are ground to size, while in the fourth operation, the rear main bearing *G* is ground. The next operation consists of grinding the outside diameter of the flywheel flange.

After the flange holes have been reamed under a vertical drilling machine, the crankshaft is passed to the Landis hydraulic grinder illustrated in Fig. 14, where all crankpins are finish-ground. This machine is arranged to enable each crankpin to be revolved about its own axis, so that all pins can be ground at one setting of the work in the machine. A Pratt grinding gage is also used in this operation.

Turret Lathe and Internal Grinder Operations

Two operations are next performed on the ends of the crankshaft in Warner & Swasey turret lathes. The first of these, which is illustrated in Fig. 17, consists of taking cuts on the flywheel end. Two tools are mounted on the front toolpost of the cross-slide, one of which faces the flange on the front side while the other chamfers it. A circular form tool on the rear slide finishes the oil-thrower groove.

When these tools have completed their work, the turret is advanced to drill hole *N*, Fig. 1. Then the turret is indexed, and a tool on a slide is advanced to bore the recess near the bottom of that hole. Another slide tool on the next face of the turret is then advanced to bore the hole. A reamer on the fourth side of the turret finish-reams the hole, and a tool on the fifth side chamfers it.

In the second turret-lathe operation, three tools on the rear side of the cross-slide face the shoulders of *L* and *M*, Fig. 1, to length, and various tools on the turret drill, bore, counterbore, tap, and chamfer the starter jaw hole *O*.

Hole *N* in the flywheel flange is then ground to size within plus or minus 0.0005 inch in the Bryant chucking grinder shown in Fig. 15. For this operation, the front end of the crankshaft is held in a chuck, and the back main bearing at the flywheel flange is supported in a split bearing as shown. The hole is ground until it reaches the desired size, as indicated by the needle of the dial gage *A*, this needle being actuated by a lever that is in contact with the surface being ground.

Final Operations Which Insure Accuracy

Several minor operations, such as milling the keyways and countersinking the flange holes, are performed next, after which all the bearings and crankpins are lapped in speed lathes. The back of the flange is next ground, and then the crankshaft reaches the arbor press shown in Fig. 19, where all bearings are straightened with respect to the front and back main bearings. A dial indicator is used in this operation, being applied consecutively to each bearing to determine whether or not it is true with respect to the end main bearings as the crankshaft is revolved. When this operation has been performed, the crankshaft is thoroughly inspected with gages of various types.

Fig. 18 shows a fixture employed for checking the stroke of each crankpin. For this operation, the flywheel end is held on a head that can be accurately indexed to suit the radial positions of the various crankpin axes. The gear end of the crankshaft is supported on the center of the tailstock. By indexing the head, it is possible to bring the different pairs of crankpins to their highest position. Then, after locking the head, the throw of the crankpins that are uppermost is determined by running the spindle of a dial gage on top of the crankpin in the manner shown in the illustration.

After complete inspection, the crankshaft is balanced statically and dynamically. An Olsen machine is employed for determining the amount of unbalance in the crankshaft.

Small Shops Should Study Automobile Plant Methods

It is often said that the methods used in automobile shops are not applicable in plants where the production is comparatively small. This idea is erroneous. There are many methods in automobile shops that, slightly modified, could be applied to great advantage in other shops. Manufacturing methods that give the highest possible rate of production without sacrifice of accuracy are the constant aim not only of automobile production engineers, but of manufacturers in every machine-building field. The article "Time-saving Operations on Pistons and Connecting-rods" in November MACHINERY, which will describe special methods and operations that have effected economies at the Nash Motors Co.'s plant at Racine, Wis., will give points on advanced manufacturing practice that may also be applied in other fields.

* * *

MEETING ON MEASUREMENTS

Measurements will be the subject of a meeting to be held under the joint auspices of the ing Devices and Use of Optical Museums of the Peaceful Arts and the Machine Shop Division of the American Society of Mechanical Engineers, Wednesday evening, October 17, in the Engineering Building, 29 W. 39th St., New York City. Dr. George K. Burgess, director of the Bureau of Standards, will preside. Two papers will be presented, the first by Professor James A. Hall, of Brown University, on the subject "Measuring Devices, Primarily Manual"; and the second by Professor Earle Buckingham, of the Massachusetts Institute of Technology, on "Development of Automatic Measuring Devices and Use of Optical Methods."

After the discussion, the meeting will be adjourned to the Museums of the Peaceful Arts to view an exhibit of measuring devices. This exhibition will be opened that night and will remain open for one month.

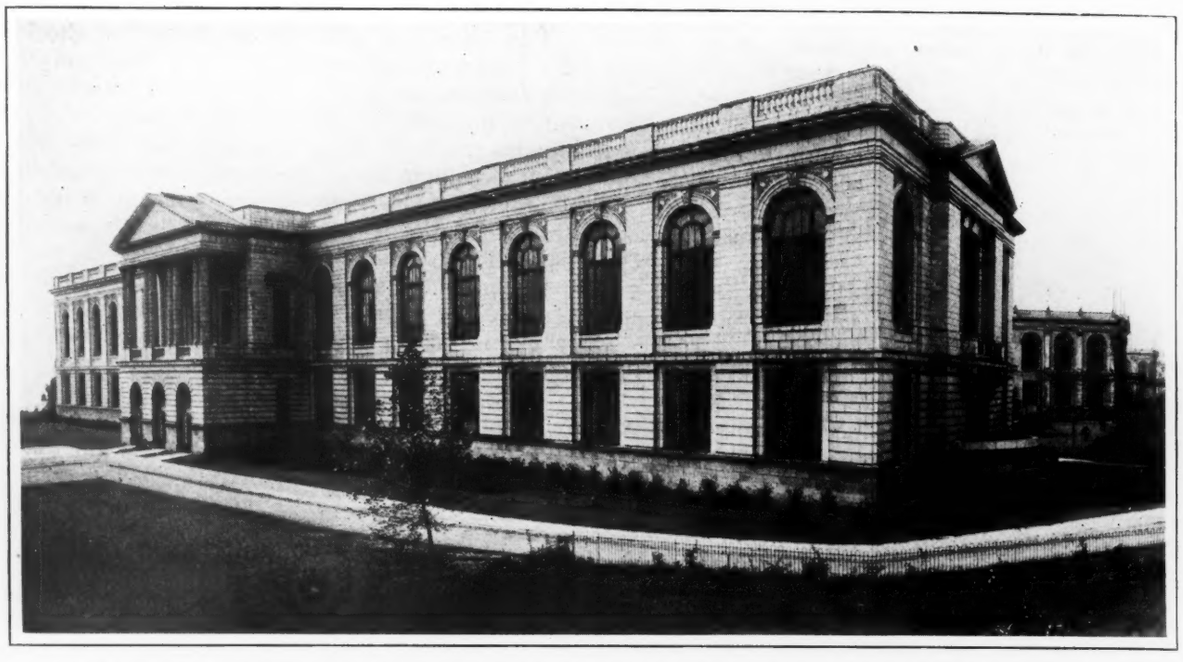
* * *

PRIZES FOR EARLIEST AUTOMOBILES

In order to bring out the oldest automobile and the oldest motor vehicle showing indications of present tendencies in design, the National Automobile Chamber of Commerce has organized an "old car" contest, the schedule of prizes of which was recently announced. The competition is open to all owners of cars, trucks, or buses built prior to 1900. The winning car or cars will be exhibited in New York at the time of the National Automobile Show in January.

* * *

If W. L. Johnson, who contributed an article, "Making Shop Drawings for Record," will send us his present address we will be pleased to communicate with him.



The Philadelphia Commercial Museum where the National Metal Exposition will be Held October 8 to 12

The National Metal Exposition

DURING the week beginning Monday, October 8, the National Metal Exposition will be held at the Commercial Museum in Philadelphia, under the auspices of the American Society for Steel Treating, a national organization of manufacturers and users of steel having a membership of over 5000. The first exposition held under the auspices of the society was staged in Chicago in 1919, when fifty-two exhibitors occupied a total of 6500 square feet of exhibition space. From that modest beginning the exposition has grown until last year in Detroit it had some 315 exhibitors occupying 93,000 square feet of space. The space available at the Commercial Museum in Philadelphia where the exhibition is held this year is 80,000 square feet. There will be approximately 300 exhibitors.

Concurrent with the exposition there will meet in convention the members of three societies—the American Society for Steel Treating, the American Welding Society, and the Institute of Metals Division of the American Institute of Mining and Metallurgical Engineers.

Dr. Hatfield will Deliver the Campbell Memorial Lecture

One of the noteworthy events at the convention of the American Society for Steel Treating will be the Campbell Memorial Lecture, which will be delivered this year by Dr. W. H. Hatfield, director of the Brown-Firth Research Laboratories, Sheffield, England. Dr. Hatfield's paper will be entitled "The Application of Science to the Steel Industry," and will deal with such topics as steel-making problems, manipulation and treatment, special steels, corrosion and acid resisting steels, effect of heat, heat-resisting steels, and tool steels and cutlery.

Dr. Hatfield is recognized as one of the world's leading metallurgists. He has been actively engaged in the steel industry since his graduation from Sheffield University, and has presented over fifty papers before various technical societies. He is also the author of several books on metallurgical subjects.

Dr. Hatfield has been invited to lecture at a number of American institutions after the Philadelphia convention, among which are Yale University, Massachusetts Institute of Technology, Carnegie Institute of Technology, and the University of Michigan. Dr. Hatfield's lecture will be the third since the establishment of the Campbell Memorial Lecture by the American Society for Steel Treating in honor of its late founder member.

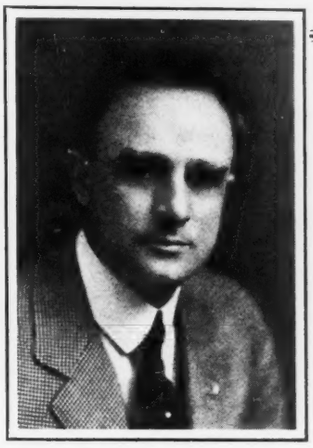
Exhibits at the Metal Exposition

The exhibits at the exposition will be of a varied character, applying both to the ferrous and nonferrous fields. Heat-treating equipment will, of course, occupy a very prominent place, and so will forging equipment, small tools, and shop accessories, as well as inspection equipment, materials handling devices, and welding machinery of various kinds. The latter division, in fact, will be one of the sections that will especially hold the visitor's interest. Approximately 10,000 square feet will be devoted to an exhibit of welding supplies and equipment. A separate part of the Commercial Museum has been set aside for this feature of the exposition which is carried on in cooperation with and under the auspices of the American Welding Society.

Philadelphia is an excellent convention and exposition city. It is estimated that there are over one and one-half times as many metal-using and metal-working plants within a radius of 150 miles of Philadelphia as in any similar area in the United States, except if a circle with a similar radius were drawn with New York City as a center.

Getting the Most Out of Men

By WILLIAM A. ROCKENFIELD, Vice-president, High Speed Hammer Co., Rochester, N. Y.



A GREAT deal has been written about how to get the most out of machine shop equipment and how to utilize machinery and tools to the best advantage; but too little thought is given to developing men so that their latent abilities may be best utilized both to their own advantage and to that of the industry they serve.

My experience in guiding industrial undertakings has taught me to look upon men as a greater asset in an enterprise than the mere physical assets of machinery and buildings. During the last year or so I have had an opportunity of looking into the workings of several organizations to determine their real value as going concerns. I have become more and more convinced that the balance sheets that show merely physical assets are of comparatively small importance. If behind the balance sheets there is a body of capable, enthusiastic men willing and able to cooperate with one another toward a common end, then even somewhat discouraging figures may be faced with confidence. With the right kind of leader, an organization of that type of men will make a success of any business.

On the other hand, no matter how promising the balance sheet, if the organization behind it is not made up of men that have been trained to take responsibility, to cooperate, and to produce results, the business is one that will not make great progress.

Machinery and Buildings Can be Bought—Loyalty and Teamwork Cannot

Physical assets can be duplicated easily enough. Wherever there is a promise of a prosperous business—and that promise depends on the character of the men connected with it—money is easily available for erecting buildings and buying machinery. Physical assets can be duplicated, but the loyalty, the initiative, and the enterprising spirit of men cannot be bought. The spirit and pride of accomplishment is latent in every man, but it must be given a chance to develop. You can hire men capable of these qualities, but it is a matter for the management to develop them to the fullest extent. They are qualities that a management must *earn*, rather than pay for. You can hire men to wait for things to happen, but you must inspire them with the desire to make things happen.

How to earn this intangible asset is not a matter of fixed rules. It depends generally upon the character, integrity, and ability of the chief executive. If he is himself a good team worker, he will develop teamwork. If he is fair, he will build up loyalty. If he knows how to lead rather than to "boss," he will develop initiative and enterprise in his men; and last, but not least, if he can share the glory of accomplishment with them unselfishly, it can be done all the faster.

The main point I want to emphasize is that profits are not made out of capital, or from one major idea or invention. Profits are made by men, by the collective day-to-day ideas, and the meeting of contingencies that continually arise; the financial record of an organization stands or falls on the personal and collective abilities and initiative of the men that comprise the organization.

How to Develop Initiative and Responsibility

While there are no general rules for developing men so as to bring out the best that is in them, in the way of ability and initiative, there are some general principles that every manager can apply to advantage.

One relates to the matter of suggestions. The manager should make it a rule always to listen respectfully to any suggestions made for improvements in design, working methods, or working conditions. I do not believe that it is good policy to dismiss a suggestion by the mere statement that it won't work. If a suggestion does not seem workable, logical reasons should be presented why it does not seem practicable. If the man who has made the suggestion still remains unconvinced, it is well to let him try it out, if the expense is not too great. Sometimes he will be found to be right, and in that case a real gain is made. If he is wrong, he has convinced himself on that point, and will save your time and his own by being more careful in thinking out the solution of his problems in the future. Furthermore, he has been given his chance, he has been recognized as more than a cog, or a purely manual laborer, and if he has another good suggestion he will bring it forth when he feels sure that it will work.

How to Get the Most Out of a Suggestion

A good plan in regard to suggestions is to ask the man making them to *write out in detail* what he has in mind. This is the acid test. When he has to put the idea on paper he will either find some of its shortcomings or he may discover that it is not so complete as it should be, and he will round it out into a successful proposition before definitely submitting it. A great amount of time may be wasted in every organization by arguing about or discussing methods and designs when a carefully written out study of the subject would dispose of the matter almost immediately one way or another.

Don't be too afraid of mistakes being made. It is by mistakes that men learn, and if they are not

too costly, they are generally the best investments a firm can make. They prevent similar mistakes on a larger scale later on, and it is only through the experience taught by mistakes that we really learn anything. The man who said "He who never makes any mistakes, generally doesn't do anything else either" was not far from wrong.

Giving Men a Chance to Develop

I believe that the greatest secret of successful business management is the willingness to give men a chance to develop their abilities. I believe in using the utmost care in selecting men for the work for which they seem to be best fitted. When once selected, I expect them to handle their work without having constantly to refer to the general manager about details. I hire men to get results, and I expect them to be able to get results through their own initiative and ability.

Practically the same results can often be obtained in a number of different ways, and no man can say which way is the best. So long as the results are produced, the way developed by the man who is doing the work is the best way, because that is the method that he himself believes in, and because he believes in it, he is going to make it work. If you force upon him another method which may seem equally good to you, but in which he does not believe, you remove the mental stimulus, and he is not going to achieve the results he otherwise would.

In as far as possible, every man should be given the privilege of using his own judgment, and he should not be restrained in developing his own judgment and his own methods until it has been definitely proved that they are ineffective.

> My experience in guiding industrial undertakings has taught me to look upon men as a greater asset in an enterprise than the mere physical assets of machinery and buildings. Profits are not made out of capital or from one major idea or invention. Profits are made by men, by the collective day-to-day ideas, and by the meeting of contingencies that arise daily. The financial record of an organization stands or falls on the personal and collective abilities and initiative of the men in the organization.—William A. Rockenfield

Judgment and Experience Must be Gained by Each Man Individually

You cannot standardize judgment or experience —that is, you cannot expect to impose the judgment and experience of one man on an entire organization, except by demonstration. Whenever an effort is made in a business to do so, that business is in danger of stagnation, because enthusiasm will be dampened and initiative and enterprise will gradually disappear. The men in such an organization become more and more routine workers, and generally speaking, an organization of mere routine workers is not progressive.

American industry has developed as it has because of teamwork and opportunities for initiative and responsibility on the part of almost every man engaged in it. One reason, I believe, why the industries in Europe, on the whole, have not developed to the same extent is because they have been in a sense dominated by the military spirit of Europe—the idea that the manager should give detailed orders and that the orders should be carried out without deviation; the idea of bosses, rather than leaders; of blind obedience, rather than cooperation. This idea presupposes that one man can do "all" the "thinking," and creates a fear of the crime of "lese majesty" in industry. In this way men have no chance to develop anything but muscle—and muscle is fast becoming the cheapest thing in the shop.

In American industry, again, we have believed in teamwork. Each man has been given a job to do and told to get it done. In doing it, he has probably made mistakes, but he has profited by them and gradually has developed, through experience, the judgment and confidence needed to take responsibility. Thus he, too, has become a leader who, in turn, through similar methods, has developed other men able to take his place.

A good general rule that may assist the executive in answering the question: "How can I develop men to assume responsibility?" is to ask himself how "he" became an executive. The answer is invariably that he was given responsibility or had it thrust upon him. Men can develop in no other way.

* * *

RAILWAY TOOL FOREMEN'S MEETING

The sixteenth annual convention of the American Railway Tool Foremen's Association was held at the Hotel Sherman, Chicago, Ill., September 12 to 14. The meeting was opened by P. Kass, superintendent of the car department of the Chicago, Rock Island & Pacific Railway, who discussed tools and equipment required by the car department and pointed out the relation between the tool-room and the work of this department.

The relation of the purchasing department to the railway shop tool-room was discussed by D. C. Curtis, chief purchasing officer of the Chicago, Milwaukee & St. Paul Railroad. He emphasized the advantages derived from standardization, and made suggestions for future standardization work. Other subjects covered in reports by committees were, "The Proper Heat-treatment of Steel," "The Standardization of Boiler Tools," "Jigs and Devices for the Locomotive Shop," and "Rake and Clearance of Tools."

An exhibit of tools and repair appliances was held in conjunction with the convention. The display was larger than at former conventions, and many types of modern labor-saving devices were in evidence.

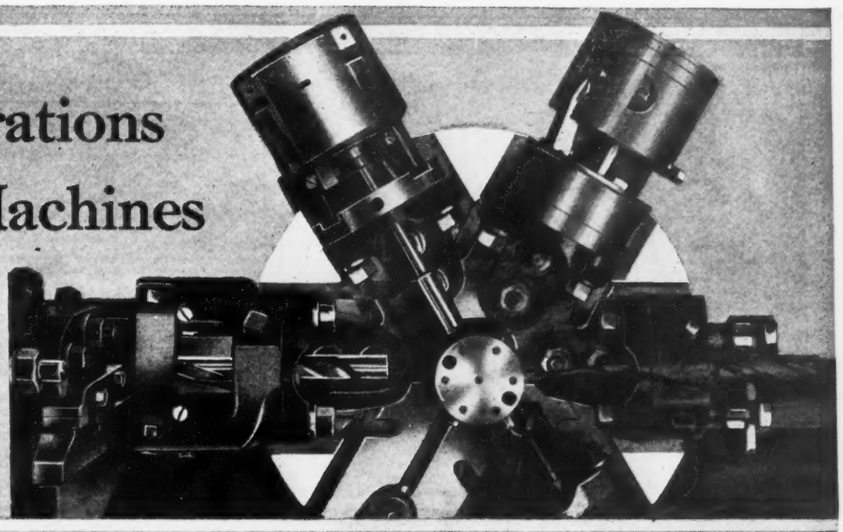
* * *

PREDICT RECORD YEAR FOR AUTOMOBILE PRODUCTION

That automobile production for 1928 will set a new high record was indicated in the reports of automobile shipments for August. Production that month reached 485,000, which is a new high total for any single month. The first eight month's figure for 1928 is only 72,000 behind the record year of 1926, and as conditions point to increased production throughout the fall, it is believed that the 1928 total will pass that of 1926, when 4,503,529 motor vehicles were manufactured.

Press Operations on Screw Machines

Tools Used in Turret of Screw Machine for Performing Piercing, Slotting, Stamping and Similar Operations



By HENRY SIMON

SEVERAL tools that have proved successful in performing press operations, when applied to the turret of a screw machine, were described in September MACHINERY, page 1. The present article deals with the design and application of such tools to screw machines under various operating conditions.

Revolving Attachment for Press Tool

In the case of the tools described in the previous article, the spindle of the machine is stopped while the tool is in operation. Sometimes, however, it is desirable that the press tool perform its work while the spindle is revolving. This can be accomplished by employing a revolving attachment, such as shown in Fig. 11. The attachment is shown in place on the shank of a press tool *F* similar to the one shown in Fig. 9 on page 5 of September MACHINERY.

It will be noted that the diameter of the stock bushing *G*, Fig. 11, in the tool has been increased and that it is faced with a fiber ring *A*. The shank of the tool runs directly in a thrust bearing mounted on the standard floating holder base of the machine. This bearing is in the form of a steel shell *B* provided with a ball thrust bearing *C*. The shank of the press tool runs freely in a bronze bushing *D*, which is a light press fit in the shell, and is prevented from dropping out by a steel ring *E*, forced on the end of the tool shank. The tool thus equipped was used for handling parts in cases where, because of other demands on the spindle driving mechanism, it was not practicable to stop the spindle during the punching operation.

Performance of Punching Tools

It should be understood that the capacity figures given in the previous article are, in some instances, subject to revision downward. The maximum pressures given represent the maximum capacity of the tool, and would require a 0.062-inch incline, which is of limited usefulness because of the short stroke or travel of the punch. These figures should be discounted about 15 per cent if the slowest or 0.094-inch incline cam illustrated in the previous article is to be used. On the other hand, it may be stated that these maximum pressures, as well as the values given in Figs. 12 and 15, are thoroughly conservative, and when used as a basis of calculation in designing the tools, as explained later, will not subject the mechanism of either the tool or the machine to any undue strain.

In some cases, where it would be possible to exert maximum pressure and penetrate the maximum thickness of metal, it may not be possible to so design the punch and die that they will stand up under the work. A case of this kind has already been mentioned in connection with the cross-slotting of a part illustrated in the previous article. A similar instance occurred with the new tool in making the part shown in dotted lines in Fig. 13. As first made, the slot in the part was about 3/32 inch nearer the cut-off end. Trouble caused by the breaking off of the front portion of the die was practically overcome by redesigning the part to allow additional metal at the front end of the die.

Troubles and How They Are Avoided

Little trouble has been experienced from the breakage of punches, except in the case of very slender pin punches. The cost of these, however, is small, and duplicates are kept on hand. These punches can nearly always be replaced in the punch slide without readjusting the die. Difficulties from premature closing of the tool have been practically overcome by employing powerful extending springs and eliminating lost motion in the slides of the tool. A trouble occasionally met with is the sticking of the tool on the work stroke, due to an over-size turned or formed portion that increases thickness of the wall to be perforated. This causes the machine to stop with the blank partly pushed into the die and with the tool locked on the part.

Usually a little pressure on the hand-lever and a few taps with a lead hammer on the tool enables it to complete the punching. Only in rare cases is it necessary to take the tool apart when it has become locked. With the new tool design, this requires but a minute or so, and is done by unclamping the tool shank, indexing the turret out of the way, and

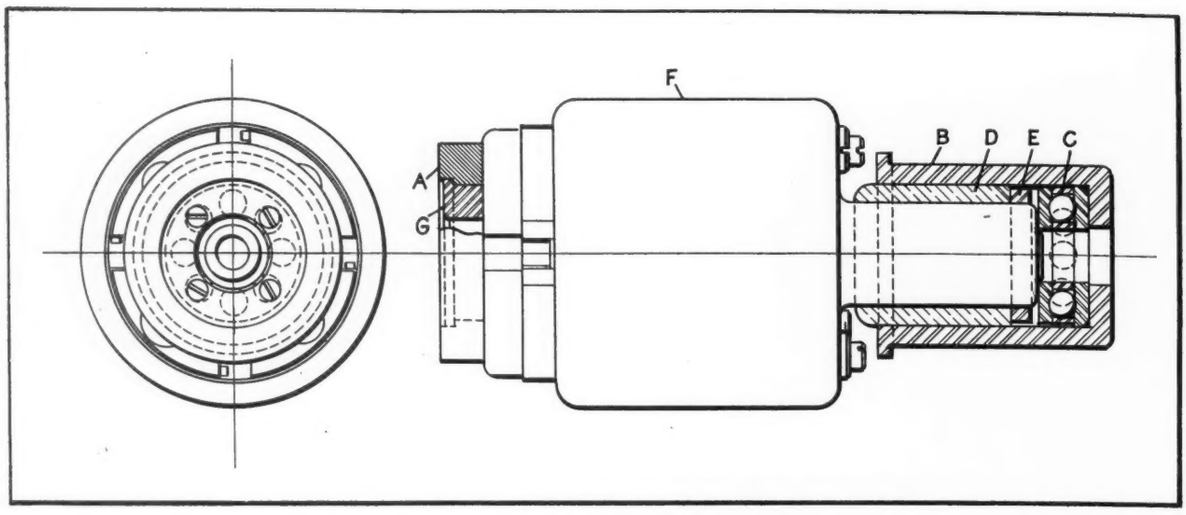


Fig. 11. Press Tool with Rotary Adapter

loosening the check screw and the holding screw of the cam connected with the punch slide that is stuck. The body can then be slipped off the cage, after which a sharp blow with a small lead hammer directly on top of the punch slide usually suffices to complete the cut and free the tool.

A difficulty occasionally encountered is the packing of the punchings in the die opening. This trouble is always confined to cases where the punchings are long and located crosswise of the die. This has happened several times in the case of the part shown in Fig. 13. Short or round punchings, or punchings formed lengthwise of the die, do not have this tendency. In other cases, it has been found that this trouble can be avoided by using about a 2-degree clearance angle in the die opening and carrying this angle to within 1/32 inch of the top surface. Each punching will then drop separately and be ejected on the index of the machine. The use of oil under pressure from the turret might at times be desirable, although so far this has not seemed necessary.

Practically no difficulties other than those mentioned have been encountered in operating the new tool, and in the writer's opinion they are the only ones of any importance that are likely to be encountered. At the worst, they emphasize the necessity of not attempting to exceed the practical scope of the new process. On the other hand, experience with the new tool has shown that there is a well defined field for press operations on the screw machine.

Many light operations of a nature that would ordinarily render it out of the question to complete a part on the machine are easily performed by employing press tools. For stamping operations not exceeding the rated capacity of the tool, the method cannot be excelled. Figures and graduations or other marks can be readily and positively stamped on the part in their correct positions relative to each other and with respect to perforations. Operations requiring half the rated capacity of the tool, or less, can usually be performed in less than the time required for handling the part in a second operation. The punches and dies required are inexpensive and the tools themselves promise to have a long life.

Factors Determining Applicability

The factors that determine the applicability of the tool to any particular job, and the time required to perform it, will now be considered. With the latest type of tool described, these factors have been reduced to formulas which, although largely tentative, being based on a limited experience, may be taken as a working basis.

There are two main factors that limit the pressure capable of being exerted by the tool: First, the safe pressure of the turret feed mechanism of the machine; second, friction between the tool cams and slides, which is the main factor controlling the efficiency of the tool. In the following, the maximum safe turret pressure for the No. 2 Brown & Sharpe machine has been assumed to be 700 pounds, and this figure is well established as being conservative. This pressure is, in fact, necessary in order to handle the largest drills commonly used on the No. 2 machine.

The maximum pressure is not, however, available under all conditions, but is definitely related to the lead and speed of the cam. This relationship has been determined approximately, as given in Fig. 12. The frictional loss within the tool and the resulting efficiency are largely controlled by the amount and distribution of the load over the punch slides. The roughly approximate relation between these several elements is given in Fig. 15, where it is assumed that

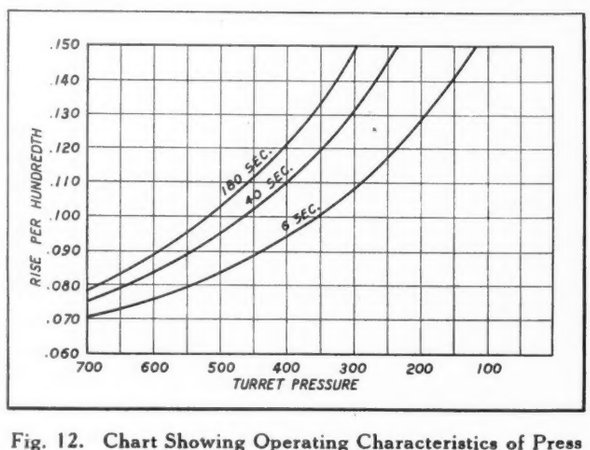


Fig. 12. Chart Showing Operating Characteristics of Press Tools Used on Screw Machine

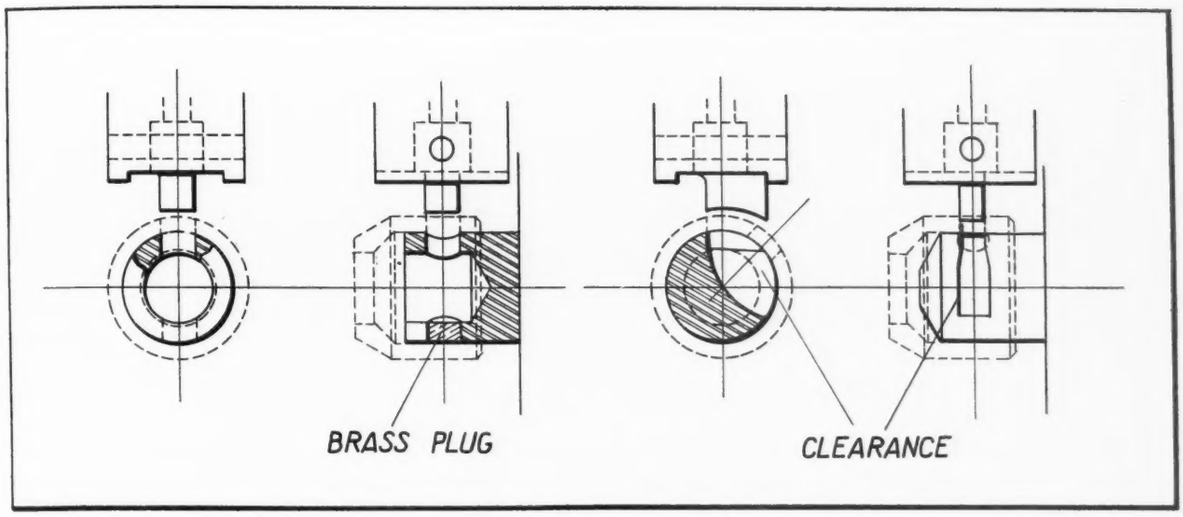


Fig. 13. Example of Tooling Equipment

the multiple punches are about equally loaded. It is probable that this chart errs on the side of too small, rather than too large, efficiency ratings.

Calculations Involved in Punch Tool Design

As an example of planning a job for a press tool of the last type described in the preceding article, let us assume that a 5/32-inch hole is to be punched in a steel part and that the wall thickness is 0.045 inch. The total pressure P required for perforating will be found by the formula,

$$P = 0.156\pi \times 0.045 \times 75{,}000 = 1650 \text{ pounds}$$

In this case, the transverse shearing strength of standard steel is taken as 75,000 pounds per square inch. The shearing strength of brass screw stock would be taken as 45,000 pounds.

Ordinarily it is advisable to select the lowest cam incline that can be used. The cam rise or incline I is found by the formula

$$I = T + 0.025 \text{ inch}$$

in which T is the distance the punch travels through the metal, and 0.025 inch the allowance for clearance between the die and the product, the yield in the tool under the pressure developed, and the necessary penetration of the punch into the die opening. The distance T represents the maximum perpendicular travel of the tool through the wall of the part. With the punch ground straight, T equals the height H, Fig. 14. Where shear is given the punch,

$$T = H + S$$

in which S equals the amount of shear. It will be clear that where H is materially greater than the thickness t, an allowance must also be made in figuring the pressure P. In the present case we have,

$$I = 0.051 + 0.025 = 0.076$$

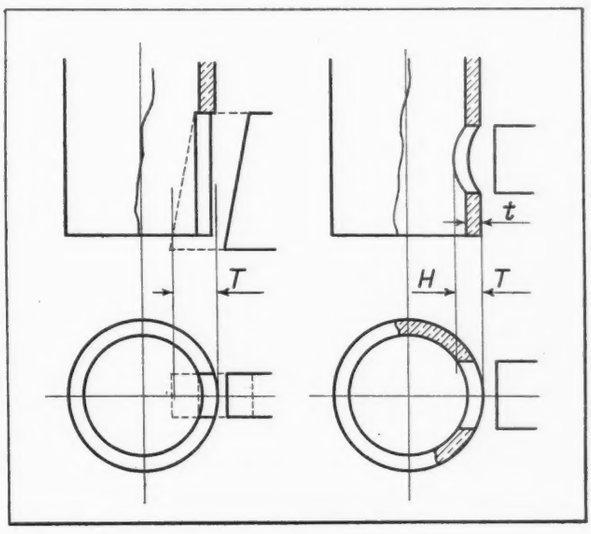


Fig. 14. Diagrams Used in Explaining Design of Press Tools for Screw Machine

This travel is within the capacity of the No. 3 cam or 0.094-inch incline. While this figure determines the total movement of the punch, it does not represent its total working travel. The idle movement can therefore be subtracted in the form of a fixed allowance of 0.015 inch, thus making the total net working stroke 0.076 — 0.015 = 0.061 inch. As the total height of 0.094 inch of the incline is for a 1-inch run, the actual required run R of the tool, or movement of the turret slide is found by the equation,

$$R = 0.061 \div 0.094 = 0.650 \text{ inch}$$

The required turret pressure F is found by the formula,

$$F = \frac{P}{L \times E} + 75$$

in which

P = total pressure required for all punches;
E = efficiency of tool;
L = leverage ratio of tool cam; and
75 = force of tool spring under maximum compression.

From Fig. 15 the efficiency of the tool for a pressure P of 1600 pounds on one slide is seen to be about 25 per cent. Therefore, we have,

$$F = \frac{1650}{10.6 \times 25} + 75 =$$

700 pounds

The corresponding lead l for the machine cam is found from Fig. 12. If the time to make the piece is 20 seconds, then the rise per hundredth will be about 0.070 inch. On a 100-second job this would be increased to about 0.080 inch per hundredth. With the run of the tool equal to 0.650 inch, the required cam surface is, $R \div l = 0.650 \div 0.070$

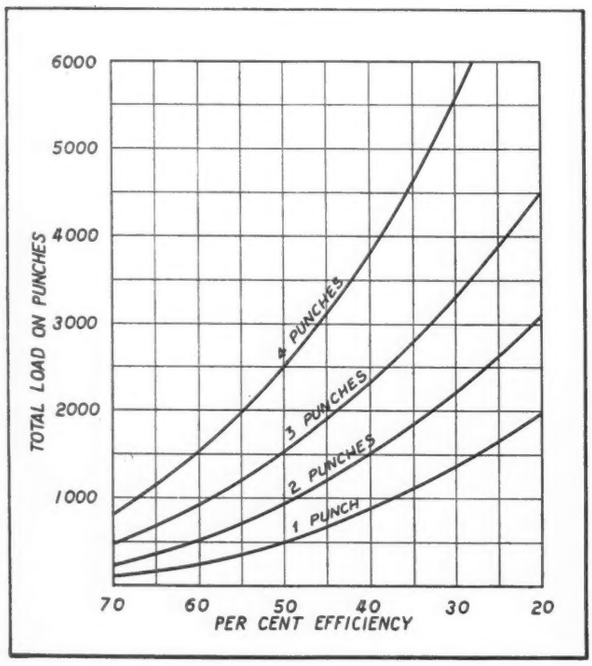


Fig. 15. Chart Showing Load on Punches and Corresponding Efficiency

= 0.0930 or 9 1/4 hundredths for the 20-second job and,

0.650 ÷ 0.080 = 0.085 or 8 1/4 hundredths

in the case of the 100-second job.

It will be found that, for the same part in brass, about 7 1/2 and 6 1/2 hundredths, respectively, would be required.

Making Punches and Dies

In making the tool equipment for any job, the punches are always made first and hardened, so that they can be used in broaching the dies. Dies are best made from non-shrinking tool steel. For offset or other intricate shapes, the bored-out die blank is mounted in the tool with the face cap removed. The slide with the punch is then pushed down and the die marked, after which the die is removed for forming the hole. A similar procedure is followed in broaching.

Contrary to ordinary practice, the punch should be the harder part, a straw temper being right, while the die should be drawn to a purple. The difference between the diameter of the die opening and the hole in the product should never be less than 0.010 inch, and can usually be increased to 0.020 inch or more. The clearance angle in the die should be from 1 to 2 degrees on a side.

In regard to the tool itself, some of the frictional factors will doubtless be of interest. Though all parts exposed to heavy friction have a lapped finish, it was found that the efficiency of the tools, when just completed, was increased by over 50 per cent after the parts had been "run in" a few days, or until the surfaces showed burnished marks parallel to the direction of movement.

Another point of interest is the difference in the drawing temperatures of the cams and slides. Both parts were made from tool steel. The cams were drawn at 400 degrees F. and the slides at 450 degrees F., so that one was materially harder than the other. As a contribution to the knowledge of sliding friction, it may be recorded that no signs of abrasion were observed, although some of the cams and slides operated many thousands of times at a pressure on an individual punch slide of 2000 pounds, or considering the contact area of the slide, 12,500 pounds per square inch.

* * *

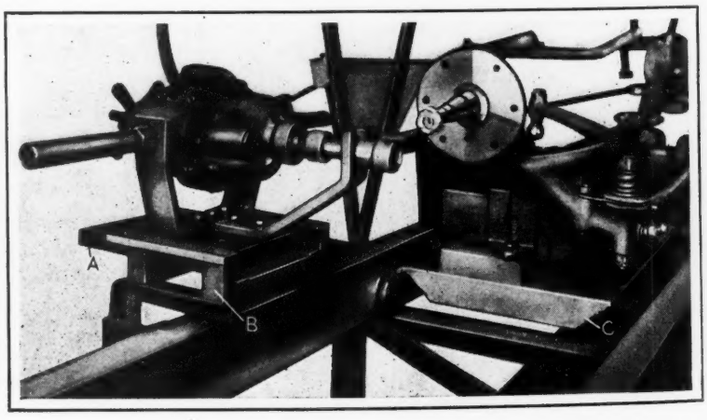
AIR DRILL USED ON ASSEMBLY LINE

Pneumatic drills employed along the assembly lines of automobile plants for setting nuts, driving screws, etc., should be so arranged as to permit them to be used with the least possible effort on the part of assemblers. The accompanying illustration shows the mounting of an Ingersoll-Rand air drill along the front-axle assembly line in the Racine, Wis., plant of the Nash Motors Co. This drill is employed for tightening castellated nuts on steering arms when they are being assembled on steering knuckles.

The equipment is mounted on a simple slide *A* which can be conveniently moved back and forth in base *B* at right angles to the path of the assembly track. The axles being assembled are mounted in carriages such as shown at *C*, and these carriages are stopped in front of the air drill in the proper position for the nut-tightening operations. This arrangement of the air drill relieves the user of heavy manual effort and results in considerable saving in time.

* * *

A scrap yard in the Middle West had a 3 1/2-ton cast-iron split flywheel to reduce to handling size. Each half of the casting had a 7-foot radius, measured 24 inches across the face, and a thickness at the rim of 3 1/4 inches, except at the center, where a rib on the inside increased the thickness to 6 1/2 inches. While cast iron is more difficult to cut with the oxy-acetylene process than either steel or wrought iron, it was found possible to handle the heavy work with a small acetylene generator of the portable type. The total time required for making two cuts was forty minutes. The gas consumption was 250 cubic feet of oxygen and 50 cubic feet of acetylene.



Convenient Arrangement of an Air Drill along an Automobile Plant Assembly Line

What MACHINERY'S Readers Think

Brief Contributions of General Interest in the Mechanical Field

TRADING IN OF OLD MACHINES

In discussing uses for old machine tools on page 900 of August MACHINERY, neither writer mentions one important field for old machines. A manufacturer who has only occasional need for the performance of a certain operation may find an old machine a distinct boon. To buy a brand new machine would not be a good investment under these circumstances, because the limited use of the equipment would not warrant the investment.

It is here that old machinery picked up at a bargain serves a purpose. For example, a manufacturer's regular work may be done on small precision lathes, but he may have occasional use for a large heavy-duty lathe. F. KAHN

FURNISHING TOOLS TO WORKMEN

The equipment of the average machinist, as mentioned on page 902, August MACHINERY, is of vital importance. While it is a considerable burden to the young machinist to purchase a full set of tools, it is not an unreasonable one if viewed in the light of the cost of the education of men in other fields or if compared with the long apprenticeship at meagre wages that older mechanics were compelled to serve. The important point probably is that the young mechanic does not have the cash available at one time to purchase a complete set of tools.

The growing use of "deferred payments" should point the way to a solution. Wouldn't it be reasonable to inspect the equipment of a new man when hired, supply him with whatever is lacking in full equipment for the work in hand, charge him at cost, and have him pay so much a week? This would be of benefit to both the company employing the man and to the machinist himself. The title to the tools would rest with the company until they were paid for. If a man were discharged, he could either complete the payments immediately or return sufficient tools to make up the unpaid balance.

GEORGE E. GERGELY

SUGGESTION SYSTEMS

In order to be successful, a suggestion system must include some practical plan for developing every good suggestion. The writer has observed that men having wide experience, which renders them capable of making valuable suggestions, often fail to do so, either through lack of interest or because they are too modest.

There should be some systematic method of instilling or developing the art of observation and constructive analysis in capable employes. To offer a certain amount of money for valuable suggestions is not enough, although every practical suggestion should be adequately rewarded. A good plan is to give carefully selected men definite assignments or positions in the organization, with instructions to make observations and prepare written reports. This would, in the writer's opinion, train men to become more observing and awaken their interest in constructive work.

Under such a plan, an employe could be sent to a certain department for a stated time and allowed to concentrate his mind upon the problem of devising possible ways and means for improving production methods. The mind trained in this way would be capable of creating ideas and working out suggestions on a more efficient and practical basis.

JOHN HOMEWOOD

PLACING A MAN IN THE RIGHT JOB

The observations under the title "Square Pegs in Round Holes" on page 865 of July MACHINERY are interesting. Much can be gained by intelligently transferring a man from one department to another. However, this is not a matter altogether dependent upon the management, as there are some men who "just won't fit."

If the peg is straight and sound, it is only proper that the management should endeavor to find a hole in which it will fit, but if the peg is warped and cannot be straightened, the sooner it is scrapped the better for all concerned. To devote too much attention in personnel departments to a man who does not succeed because his mental attitude is wrong, is unfair to the rest of the men, and too much emphasis cannot be placed on mental attitude and character, for they are the keys to success. If a man is careless, takes an antagonistic attitude, and has objectionable habits, he is a detriment to the organization, and the sooner he leaves the better.

The desire to learn, aggressiveness, and self-reliance are attributes that will eventually win, even though a man may fail completely at some specific task. To aid that man in finding his particular job is of advantage both to the man and to the company; but if a man shows signs of being lazy and indifferent, all the altruism in the world will not salvage him, and there are too many really worth while men looking for jobs to waste much time on him. FRANK M. TUOHY

KEEPING SALESMEN WAITING

The handicaps under which a salesman works are well described on page 865 of July MACHINERY. The price reductions of the last decade are practically all traceable to the study and refinement of production problems, while sales problems have more or less been permitted to drift along. The utilization of the salesman's time is the very core of the problem. In general, it is not often the really big executive, with every reason to be busy, who

keeps the salesman waiting, but a minor executive, who feels his own importance.

The salesman can help if he will try to notify a company of his proposed visit in advance; just "dropping in" often is inconvenient to the prospect. Deleting polite conversation about irrelevant matters will certainly be appreciated in these days. It has no place in modern salesmanship. Equipping himself with detailed facts, rather than enthusiastic generalities, will also make the salesman more welcome.

The management of the purchasing concern can help by fixing a maximum limit for the time a salesman may be kept waiting. A sign in the reception office to this effect or instructions to the telephone girl or office clerk will take care of this. Definite days and times when the buyers or purchasing agents will be available for interviews will also help the situation. The problem, after all, is not nearly so difficult as many of the design and production problems that have been solved—it is just a plain case of getting together and cooperating.

JAMES P. CONNOR

DRAWING STANDARDIZATION

As pointed out on page 861 of July MACHINERY, the drafting-room certainly has been overlooked in the work of standardization. While it is highly desirable to define what is meant by a drawing, plan, or map, and to standardize the size of sheets used, there are matters of still greater importance that need standardization. I would list some of these as follows:

1. Conventional signs for such items as valves, rivets, etc.
2. Standardized methods of expressing tolerances.
3. Easily drawn cross-section conventions to indicate material.
4. Rules as to the use of inches and feet in dimensioning (up to what limit should inches alone be used).
5. A standard establishing the relationship of the three views—plan, elevation, and side view.
6. Standard for indicating threads.
7. Standard for the position of a side view on a drawing. In ship practice and automobile practice, the forward end of the final assembly drawing is reversed.
8. A minimum size for letters and figures on drawings.

The standardization of these items will facilitate the interchange of draftsmen between different fields of engineering and will make it unnecessary for an experienced draftsman on a new job to revise his habits and learn new conventional practice. In the shops of contract manufacturers, working to outside drawings, such standardization would prove a real benefit.

A. D. KLIGMAN

I hardly agree with the article on page 861 of July MACHINERY "Drawing Size Standards." Engineers and draftsmen have for some years standardized the method of making conventional drawings for their particular field of work. There is a sign, for example, that indicates center line; the electrical draftsman has a small symbol that indicates a motor outlet, and a numeral in the center of the same symbol to indicate horsepower; the topographical draftsman has a symbol to indicate a railroad, and so on.

All other methods of making drawings relating to projections, dimension lines, etc., are in a general way followed by all draftsmen, so that if a ship draftsman should take an architectural draftsman's drawing, he would have no trouble in reading it, except that he might not understand some of the architectural symbols; but these he could easily find in a handbook, as such symbols have long been standardized.

It would not seem advisable for all concerns to standardize the size of their drawings to either the "five factors series" or to the "letter-head multiples series" merely for the sake of simplicity of filing. I believe that each concern should have its own standard size of drawings, possibly five sizes, depending on the product manufactured by the concern. The drafting-room making drawings for ship bulkheads could not very well make such a drawing on the same size sheet that would be suitable in a drafting-room detailing screws or bolts. If a drafting-room decides that its smallest drawing should be 10 by 15 inches, filing cabinets should be bought to take that size, and all the larger drawings folded to that size, except tracings, which should be rolled for filing.

The various sizes of tracings should not affect the width of the blueprint paper. If a tracing is not so wide as the roll of blueprint paper, the additional width may be used for a smaller tracing to eliminate waste.

MORTON SCHWAM

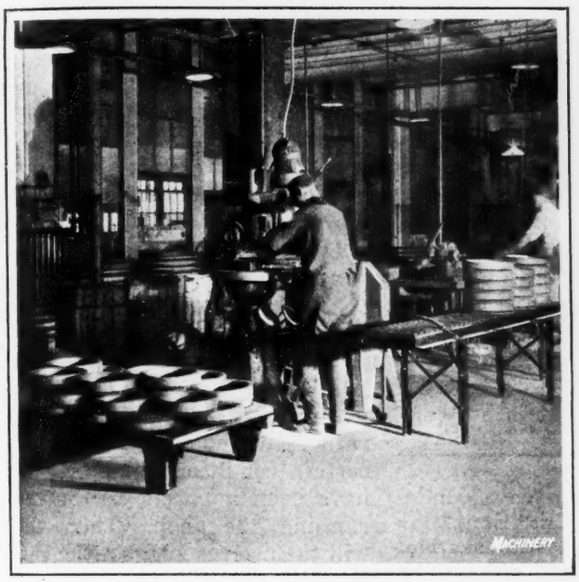
Although standardization of materials, methods, machines, and parts is of great importance in modern mass production, it may sometimes be carried beyond the most economical point. The standardization of drawing sizes is one thing which may easily be carried too far in the drawing-room of the job shop. Owing to the diversity of its product, it is usually more economical for the job shop to use the design or assembly drawing for shop reference than to make detail drawings for all parts, unless there are a number of machines to be made on one order or unless there are repeat orders at frequent intervals.

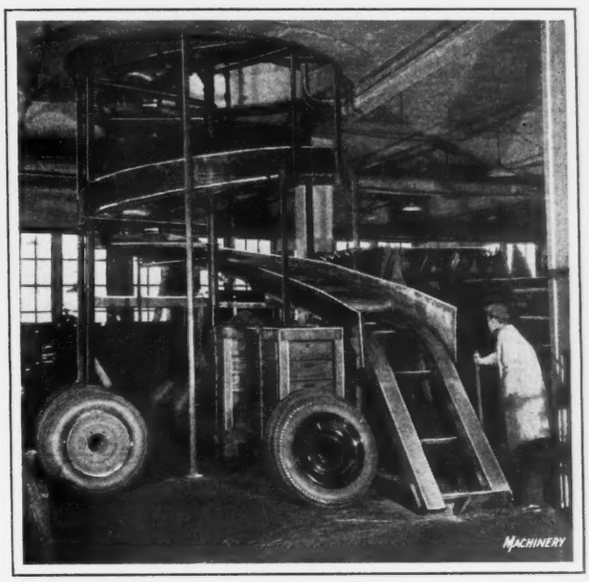
To lay out all design drawings to suit standard sizes of sheets of paper, would require considerable time and planning on the part of the draftsman, which could better be expended upon the design of the machine. Another disadvantage in the use of standard sizes of sheets is that, in adapting the layout to these sheets, it is probable that the draftsman will choose views and a scale calculated more upon fitting the drawing to the sheet than upon showing the design to the best advantage for shop use.

Although the use of sheets cut to standard sizes may effect some saving in the purchase of the paper and in the filing of drawings, it often results in poor economy in the job shop engaged in building special machines.

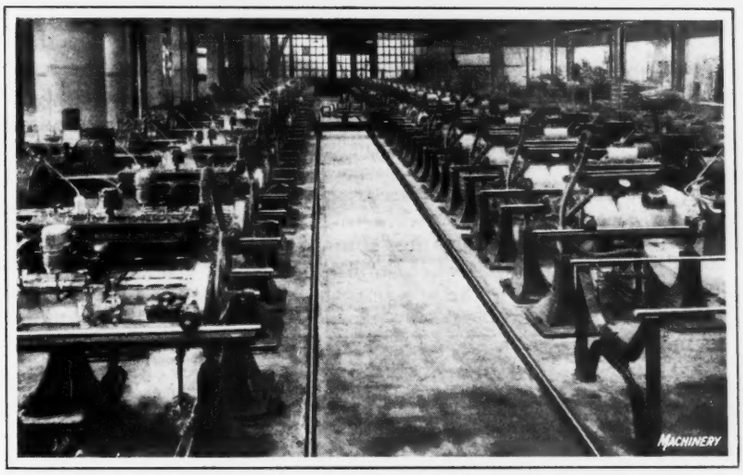
W. L. ROMICK

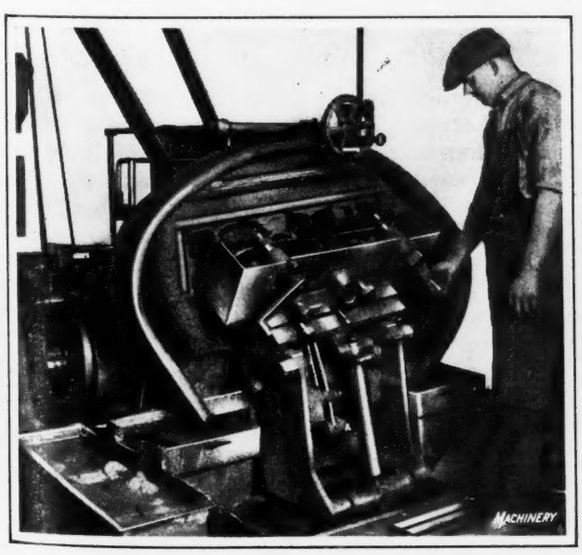
Methods in the Packard Plant

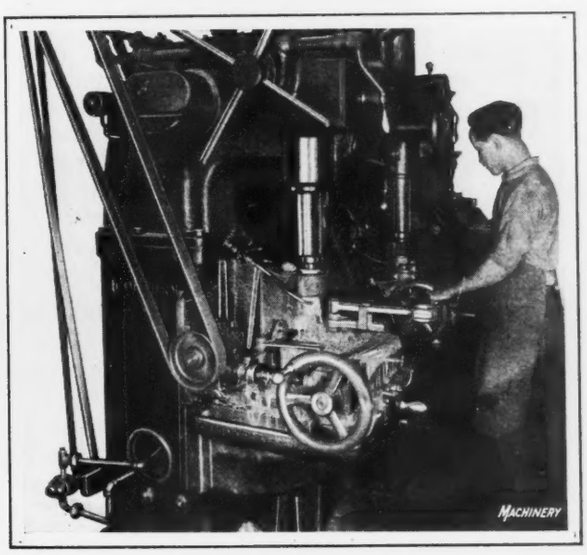




Some of the methods used in the plant of the Packard Motor Car Co., in Detroit, are shown in the accompanying illustrations. To the left above is shown one end of the Packard flywheel line-up, where efficiency has been materially increased through the rearrangement of machines and the use of a simple conveying system. To the right above is shown how wheels are delivered to the assembly line by means that effectively prevent scratching the finish-painted surfaces of disk wheels. The picture in the center shows the arrangement of the jacking room, where engines are run-in for nine hours, driven by electric motors. The delivery truck carries engines at the same height as test blocks, no hoisting being required. To the left below is a surface grinding machine finishing exhaust manifolds in less than one-tenth of the time required by previous methods. To the right below connecting-rods are profiled by hollow-milling in a heavy-duty drilling machine.







How Greater Efficiency May be Obtained

By CRIS BERG, Engineer, Chicago, Ill.

THE writer's long experience in industrial engineering work—in the organization of factories for increased production and in the introduction of cost-reducing methods—has convinced him that even shops that may seem to be quite well equipped offer possibilities for increased efficiency. Frequently such shops, when everything is carefully studied and methods for increasing efficiency are handled in a common sense manner, can show an increase in output, with the same equipment and personnel, of from 50 to 70 per cent.

Speeds and Feeds Can Frequently be Increased

The men in charge, although capable and conscientious, are not always fully conversant with the capacity of the tools and machines that they employ. Frequently, speeds and feeds are used that do not give the greatest output possible. The difficulty in selecting the right speeds and feeds is to obtain the best combination of the two that will give the highest output. It is not possible merely to adopt a given speed and then crowd the feed to the limit, or to adopt a given feed and then just increase the speed until the tool or machine will stand no more. The secret of success is to obtain the best combination of the two.

For example, the writer recently investigated the methods in a shop where cast-iron pulleys were turned at speeds varying from 24 to 28 feet per minute. The foreman stated that the tools would not stand up under any greater speeds. In this case, the trouble was that the steel used for the cutting tools was not adapted for this particular kind of work. Samples of suitable cutting steel for turning cast-iron pulleys at higher speed were procured, and in this way, it was possible to increase the speed to 55 feet per minute and, at the same time, double the feed. This meant approximately four times the output per machine. The new steel cost more per pound than the old, less efficient product; but the total expense for steel was reduced by discarding the solid tools formerly used, and using tool-holders and small tool bits instead.

It may be laid down as a fundamental rule, says Cris Berg, the author of this article, who has had long experience in industrial engineering work, that the outside consulting engineer's ideas are worth only as much as the superintendent and foremen of the plant that he is endeavoring to assist can be made to believe that they are worth. If the outside engineer cannot enlist the confidence and cooperation of these men, it is waste of money to engage his services. He can succeed only if he is able to make the regular organization cooperate with him and can awaken the interest of the shop men in the objects to be attained.

Can an Outside Engineer Cooperate Successfully with the Regular Organization?

We often hear it said that it is difficult for an outside man to step into a plant and achieve results of this kind, because the regular organization resents his presence. This depends entirely upon the attitude of the outside engineer. If he has tact and common sense and knows how to handle men, he will have no difficulty whatever in carrying his work through, but he must have some conception of psychology and be willing to deal with other men as he would like to be dealt with himself.

It may be laid down as a fundamental rule that the outside engineer's ideas are worth only as much as the superintendent and foremen of the plant can be made to believe that they are worth. If the outside engineer cannot enlist the confidence and cooperation of the organization, it is a waste of money to have him around at all; but if he is of the type that can make the present organization work with him, and if he can interest the men in the objects to be attained, he will succeed.

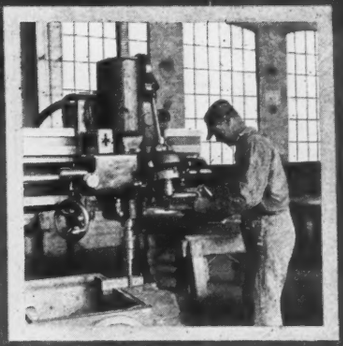
It is not for him to suggest improvements, but rather to point out tactfully certain conditions that may not have been apparent to the men running the shop. Then they will themselves suggest the remedies to be adopted. With the guidance of the outside engineer, improvements will thus be installed that have been suggested by the present supervisory force and that, therefore, will have the whole-hearted support of everybody concerned.

The reason that so many so-called "efficiency engineers" have failed to achieve permanent results is because they have come into the shop with the idea of reorganizing everything according to some pet scheme of their own; they have upset the existing organization, created antagonism, and failed to convince the men who were ultimately to run the new scheme, of its practicability. The man who succeeds is the man who gets the regular organization to make the suggestions, to do the work, and to take pride in the results.

* * *

The average freight train today is a more economical, speedy, and efficient means of handling freight than ever before. Eight years ago a freight train averaged 10 miles an hour, while now it averages 12.8 miles an hour, an increase of about 28 per cent. During the same period the number of cars has been increased from 36 to 48, or 33 per cent. In order to move freight quickly, it is necessary to move cars that are not loaded to capacity, and there has been a decline in the average number of tons of freight to each loaded car. However, despite this decline in the load per car and also despite an increase in the number of empty cars per train, due to the efforts of the railways to provide cars for shippers quickly, the average freight train, because of its increased length and speed, renders more freight service than formerly.

Letters on Practical Subjects



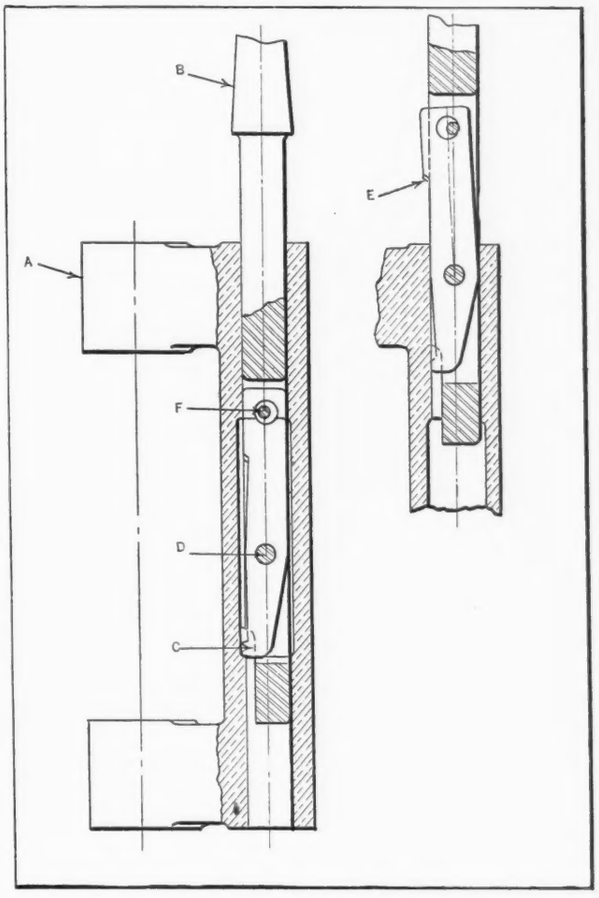
CUTTING RELIEF IN LONG BEARING

In the accompanying illustration is shown a tool for cutting a relief in a 1/2-inch hole, which automatically starts the relieving cut at a definite depth. In the view at the left, the tool is shown in operation, while in the view at the right, the blade is shown in the position it occupies when being withdrawn from the recessed hole. The work *A* is a brass casting, 7 inches long, having a 1/2-inch reamed hole which is relieved for a length of 2 3/4 inches at the center of the casting. The tool is designed to automatically start the relieving cut at a point 2 inches from the top of the casting. The point at which the relief cut in the hole terminates is determined by the stop on the spindle of the drill press.

The tool consists of a shank *B*, which is slotted to receive the tool-steel blade *C*. The blade is made of flat tool steel, and is pivoted on pin *D*. It has a tapered side *E*, which forms a cam that forces the cutting point into the metal at the beginning of the recessing cut.

When the tool is withdrawn, the point falls back into the reamed hole when it reaches the position at which it commenced to cut on the down feed. The pin *F* in the large hole of the tool limits the swing of the blade. Before the recessing tool was designed, an attempt was made to drill and ream the full length of the 1/2-inch hole. It was found very difficult to produce straight drilled and reamed holes 1/2 inch in diameter by 7 inches long, and many of the castings were spoiled in attempting to do this before it was decided to recess the holes as described.

EDWARD R. JOHNSON
WALTER E. GUNNERSON
Rockford, Ill.



Tool for Cutting Relief in Bearing Hole

BORING FIXTURE FOR TRIAL CRANKCASES

In building trial engines of a new design, automobile manufacturers sometimes find it necessary to machine several crankcases for which there are no jigs or fixtures. A temporary set-up must, of course, be used, as the small number of castings involved does not warrant building production-type fixtures. However, there are certain dimensions on a crankcase, such as those that locate the position of the crankshaft relative to the cam and pump shafts, which must be held to very close limits and for which it pays to construct a few simple fixtures, such as shown in Figs. 1 and 2.

In Fig. 1 is shown a simple set-up employed on a horizontal boring machine for locating and boring the crankshaft and gear-shaft holes in a crankcase. This set-up insures accurate location of the holes, although the fixtures employed are comparatively inexpensive. An end view of the crankcase, which gives the important dimensions covering the location of the holes, is shown in Fig. 2. All surfaces bearing a finish mark are machined previous to the boring operations in order to furnish points from which to take accurate measurements.

The plugs *A*, *B* and *C* are accurately turned to a diameter of 1/1000 inch and faced square on the ends, and may be left soft for work of this kind. The plug *A* must be set so that dimension *D* will be correct, after which plugs *B* and *C* may be set in their proper positions and the diagonal dimensions for the gear-shaft centers checked. The section view of the typical crankcase, Fig. 1, shows the case mounted on cast-iron parallels *E* in position for spotting the holes to be bored in the casting.

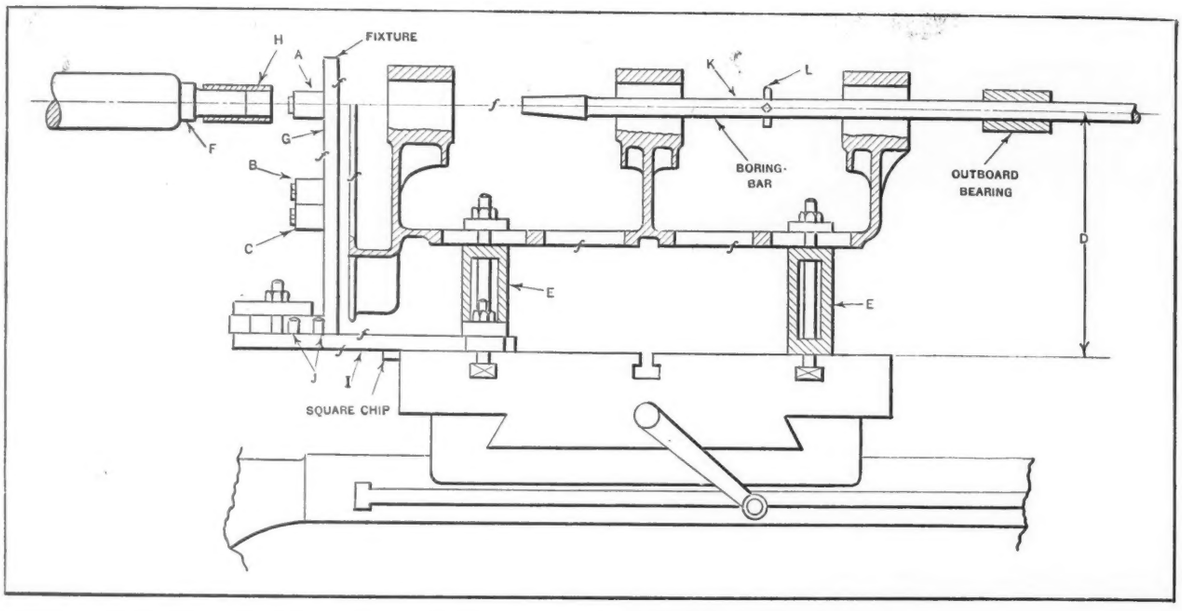


Fig. 1. Method of Setting up Crankcase for Boring Crankshaft Hole

A plug *F* is fitted to the boring machine spindle. The outer end of this plug corresponds in size to the plugs on the fixture plate *G*. A centering sleeve *H*, which is a close fit on both the plug in the spindle and the plugs on the plate, is used in bringing the spindle into alignment with any one of the plugs, as required, in locating the work for boring the various holes. Some machinists prefer to use an indicator instead of the sleeve *H* for aligning.

The crankcases should, of course, be finished on the top, bottom, and supporting arms before being sent to the machine for boring. In mounting the fixture plate *G* on its baseplate *I*, care should be taken to see that the plate is brought up firmly against the locating dowels *J* before clamping it in position, with the plug *A* in line with the machine spindle. After this is done, plate *G* is removed from the baseplate, which is left in place on the boring machine table. Sleeve *H* is next removed, and the crankcase lined up with the boring-bar *K*, which is mounted in the spindle and supported by the outboard bearing. The crankshaft bearings are then bored, employing cutters such as shown at *L*.

In relocating the fixture for boring any of the other holes, such as the one located by plug *B*, the boring-bar is removed from the casting, plate *G* put back in position on baseplate *I*, and plug *B* brought into alignment with plug *F* and sleeve *H*. The same procedure is followed as in boring the first hole, and this is repeated until all the holes have been bored. The table should, of course, be clamped and checked for alignment after each change in the setting.

Glendale, Calif. H. W. RICKS

CUTTING CRISSCROSS OIL-GROOVES

The average shop handling general jobbing work is not usually equipped for specialized jobs, such as cutting crisscross oil-grooves in shaft *A* and bushing *B*, Fig. 1. Only 200 of each of these pieces were required on an order obtained by a certain shop; this quantity was not enough to warrant any great expenditure for special tools, and yet, a workmanlike job was essential. Both parts were of S. A. E. 1020 steel and had to be hardened and ground.

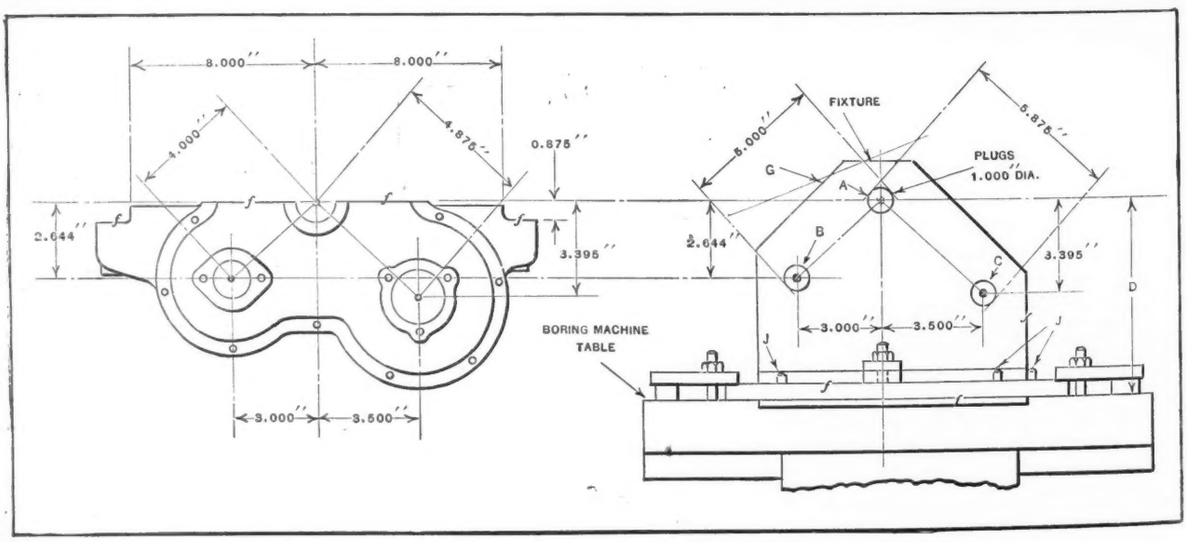


Fig. 2. Crankcase and Fixture for Locating Crankshaft and Gear-shaft Holes

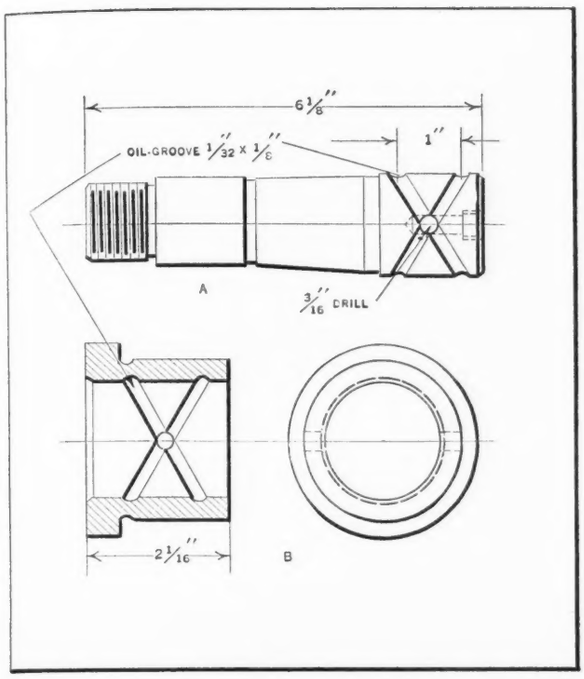


Fig. 1. Shaft and Bushing in which Crisscross Oil-grooves had to be Cut

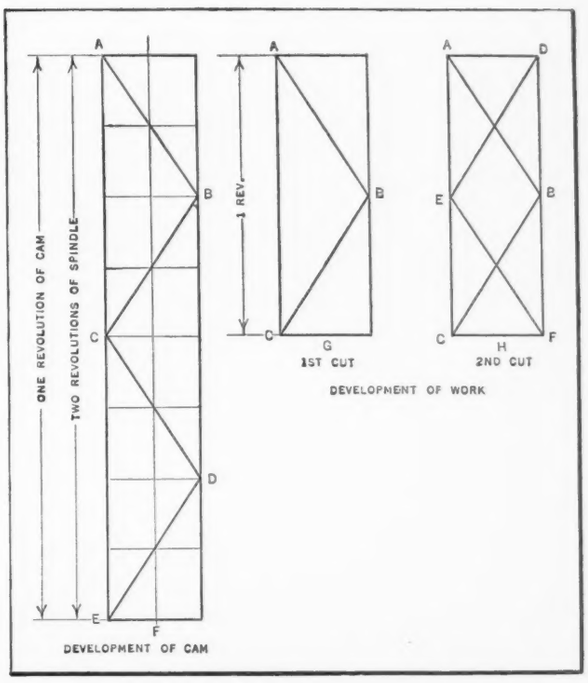


Fig. 2. Diagrams Illustrating First Method Proposed for Cutting the Oil-grooves

The foreman gave a sample of each piece to the toolmaker, and told him to make a cam that could be used on the Fox lathe for cutting the oil-grooves. A half hour later the toolmaker came back to the office with a sketch in his hand and remarked, "We'll have to index the work half way around when we do that job, in order to make the crossing of the grooves come right. I can make a cam like that at *F*, Fig. 2, having a path *ABCDE*. As this cam revolves only once while the spindle goes around twice, it will make the cut as shown at *G*, following the path *ABC* and going over the same cut twice to every revolution of the cam. We can make the grooves cross each other by indexing the work half way around. Then the second cut will be as shown at *H* in which *DEF* represents the second cut and *ABC* the first."

"I think we ought to finish the job in one cut without having to index the work, and I believe a cam can be made that will do it," replied the foreman. After several attempts, he made the diagrams shown in Fig. 4 and explained them to the toolmaker. The development is indicated by dotted lines *CDEFGDKFL* in diagram *A*. Diagram *B* illustrated how the groove was to be cut in two revolutions of the work, with the tool following a path controlled by the cam. In the first revolution of the work, the tool was to follow path *CDEFG* and in the second revolution, path *HDKFL*, which completed the double cross.

In due time, the cam was finished and applied to the Fox lathe, as shown at *A* in Fig. 3. The gearing to the spindle is shown at *B* and *C*. Follower lever *D* which has a pin *E* in it, was clamped to a

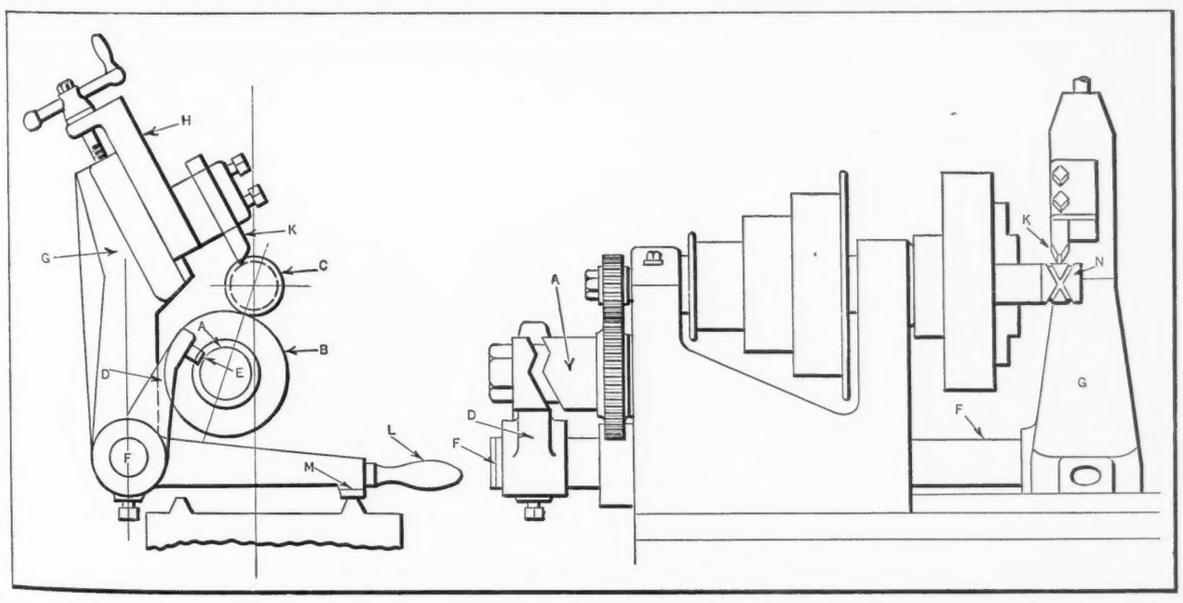


Fig. 3. Set-up Used on a Fox Lathe for Cutting the Crisscross Grooves

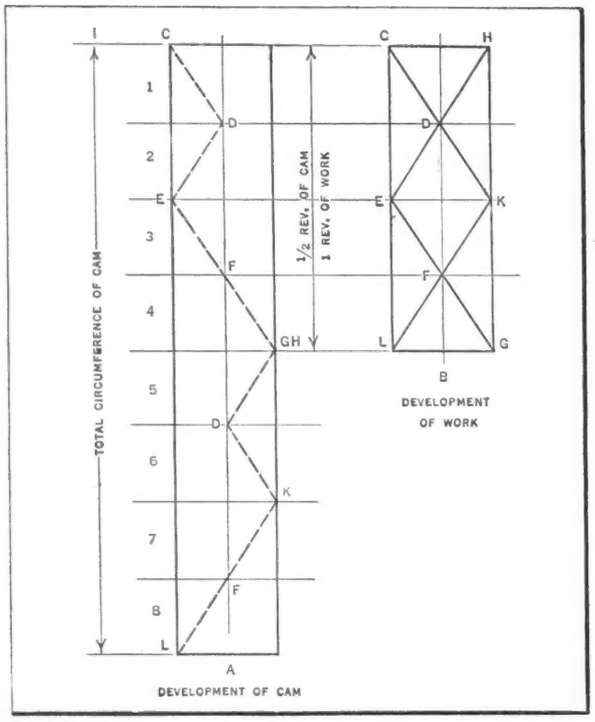


Fig. 4. Diagrams Illustrating Method Adopted for Cutting the Grooves without Indexing the Work

heavy bar *F* carried in bearings at the back of the lathe and free to float longitudinally as controlled by the cam. The tool-carrier bracket *G* was adjustably mounted on the same bar, and a tool-slide *H* allowed tool *K* to be adjusted as required. Handle *L* was a part of bracket *G* and had a hardened block at *M*, which rested on the ways of the machine. The work, as shown at *N*, was held in chuck jaws. In operation, the workman lifted handle *L* when starting the tool on the work or removing it. This tipped the entire mechanism back out of engagement.

The scheme worked efficiently and so the job was done quickly and well. In grooving the bushings, the only change necessary from the set-up shown, was the substitution of a boring-bar and holder for tool *K*.

A. A. D.

TEST FOR CORROSIVENESS OF SOLUBLE CUTTING OILS

The writer has had occasion during the past year to visit two shops where complaints had been made regarding the corrosive properties of the soluble cutting oil used. Evidently it had not occurred to the purchasers of the oil that a relatively quick test of its corrosive action could be made on a sample before using the oil in large quantities in the shop. The following test was therefore suggested, and has since been used on all newly purchased soluble oil, in consequence of which no oils that show the presence of any corrosive substance have "slipped past" into the shop.

In making the test, clean strips of mechanically polished sheet steel and copper, about 1/2 inch wide and 3 inches long, are placed separately in suitable clean tubes or sample bottles. The soluble cutting oil under test is added, so that the strips are but partly immersed, after which the tubes or bottles are closed with corks. The container is then manipulated so as to wet the metal strips completely with the cutting oil.

The tubes or bottles are next set up in an approximately vertical position and allowed to remain undisturbed at room temperature (70 to 90 degrees F.) for forty-eight hours. At the end of the forty-eight-hour period, the metal strips are removed from the containers and washed with benzol, which, in itself, must be of such purity as to pass the corrosion test satisfactorily. The presence of corrosive compounds is indicated by corrosion or discoloration of the steel or copper strips, when compared with freshly polished ones.

If the metal being machined is other than steel or copper, a strip of the metal actually used is exposed to the action of the oil. For the most dependable results in testing the corrosiveness of the oil, it is even better to maintain the strips in the oil at the same temperature as that which exists when the work is being machined. A suitable bath can be fitted up with but little trouble to maintain the desired temperature.

A soluble cutting oil should be reported as passing the test when the exposed strips show, at the most, only an extremely slight discoloration; and as not passing the test, when the exposed strips show more than an extremely slight discoloration. The idea of such a test is not entirely original with the writer. A similar test is applied to all soluble cutting oils purchased by the United States Government for use in various departments.

Denver, Colo. H. L. KAUFFMAN

DUPLEX SLOTTING FIXTURE

The plunger shown at *A*, Fig. 2, has a pair of slots on opposite sides for holding a set of pawls which form part of a friction drive mechanism. The slots are first cut with a circular milling cutter, which leaves the ends curved. One end of each slot is required to be square with the axis of the plunger, with 45-degree fillets at the corners, as shown in the upper view. Until the duplex slotting fixture shown in Figs. 1 and 2 was designed, the squaring of the ends of the slots at *a* and *b*, as shown at *A*, Fig. 2, was performed on a shaper. The ends of the slots are now finished simultaneously and with precision on the new fixture,

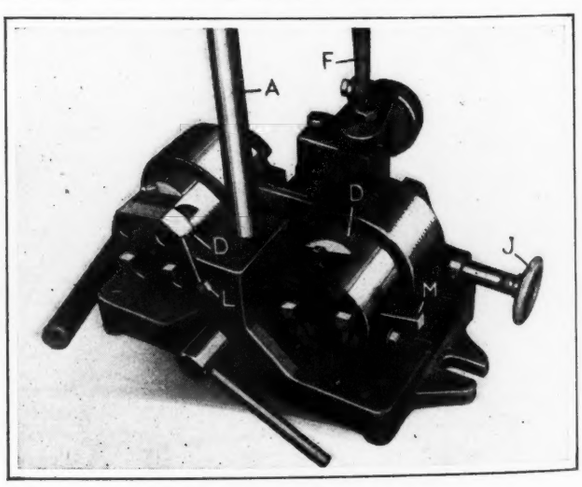


Fig. 1. Duplex Slotting Fixture

which has more than quadrupled production. The fixture is shown in Fig. 1, with a plunger *A* in position for slotting.

The fixture comprises a main base *B*, Fig. 2, and a sliding member *C*, the latter carrying a pair of cutter-heads *D*, which are rotated to give the required feed during the operation. Base *B* is secured to the table of a small milling machine, while the reciprocating slide *C* is actuated by the milling machine spindle through a simple two-tooth clutch *E*. This clutch may be slid out of engagement by means of the small handle *F*. At the opposite end of the clutch shaft *G* is a hardened roll *H*, which is supported eccentrically and which travels in a hardened steel pocket *I* fitted to the slide *C*. This provides the cutting or "stroke travel" for the slide, while the two cutter-heads *D* are rotated by means of the handwheel *J* until the slots are cut to the required depth. A pair of worms and worm-wheels *K* comprise the rotating mechanism.

The plunger *A* is held in a vertical position by the clamping screw *L* while the cutters *M* are at work. Both cutter-heads rotate in the same direction, but since the cutters project toward each other, they finish opposite ends of the two slots, as indicated at *a* and *b*, Fig. 2. Stops *S* are provided to gage the depth of the cut, and the travel of the slide is sufficient to permit the work to clear the cutters when it is being inserted in or removed from the fixture.

Springfield, Vt. O. S. MARSHALL

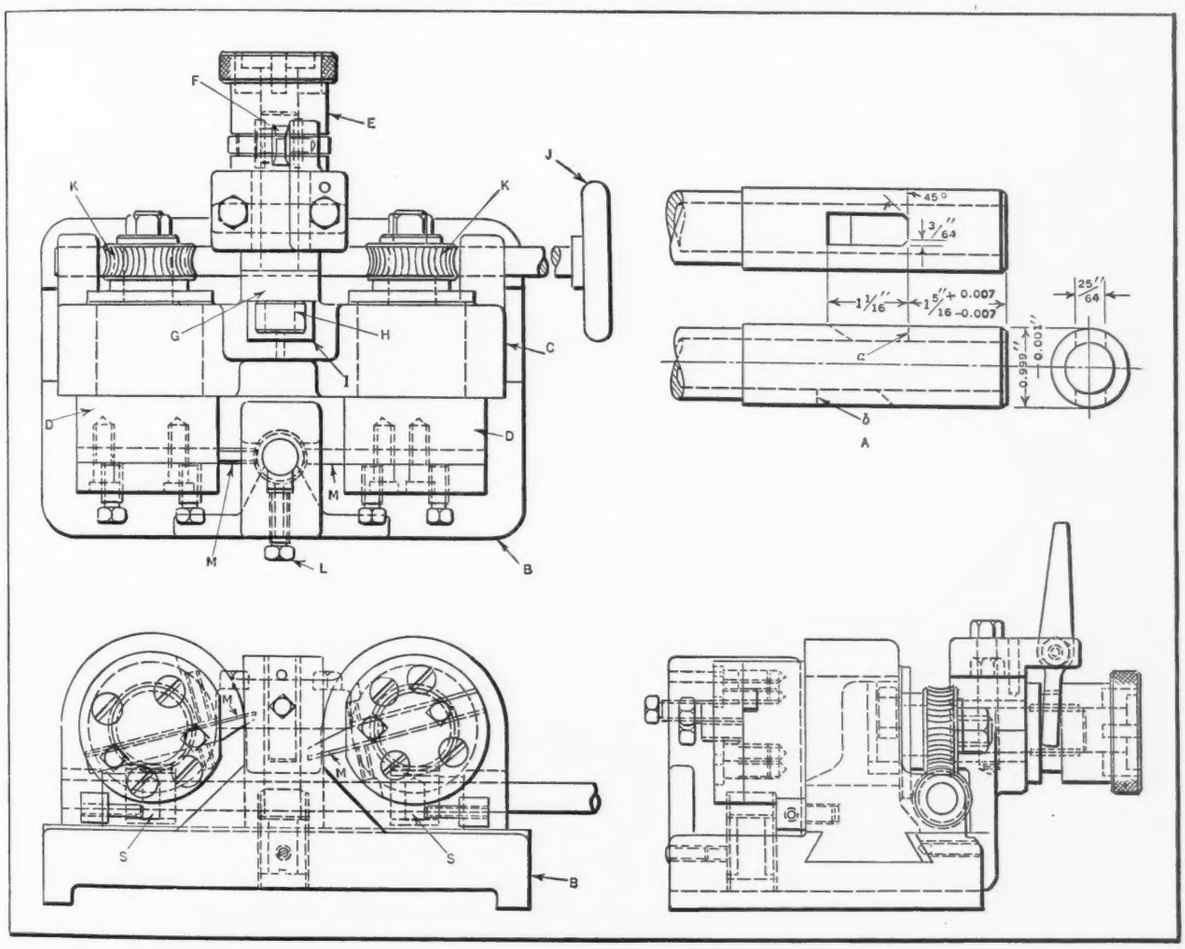


Fig. 2. Plan and Elevation Views of Fixture Shown in Fig. 1

DRAFTSMEN'S CORRESPONDENCE FOLDERS

For the benefit of new men and those of the drafting personnel who are absent on vacation or for other reason when letters of instruction are sent through the drafting-room, a correspondence file folder containing a copy of all letters of instruction or general information issued to the drafting personnel should be placed on the schedule clerk's desk for reference purposes.

Draftsmen returning from leave of absence should be requested to read over all correspondence in this folder which has been issued since they went on leave or during the period they were away from the drafting-room. Squad leaders should request new men to read over all the correspondence in the folder before starting work.

By employing the system described, the draftsmen coming back from vacation or leave will know of any changes pertinent to methods, practices, or work in the drafting-room. Also, new men will learn something of the drafting-room procedure as practiced by that particular department. A comprehensive view of the policies and practices of the drafting-room is necessary to enable the new men to get the right impression of what the company expects from them and the means and methods established to aid the new employes to meet requirements. With a system of this kind in force, many mistakes of a troublesome character will be avoided.

Merchantville, N. J. JOSEPH VIGGIANO

PREVENTING MACHINES FROM RUSTING DURING SHIPMENT

In preparing machinery for shipment, manufacturers generally coat the machined surfaces with some form of "slushing oil" to prevent rust or corrosion. Frequently, this coating consists of petrolatum-vaseline, but the following compound is preferable, as it can be more easily applied or removed: Mix about 6 1/4 gallons of paraffin oil with 25 pounds of vaseline or No. 3 cup grease, stirring the oil into the vaseline. The stirring should be continued until all the oil is taken up by the vaseline. These quantities produce about 10 gallons of "slushing oil," but any required amount can be made up by mixing paraffin oil and vaseline in the proportion of 4 pounds of vaseline to 1 gallon of paraffin oil.

Some manufacturers prefer a white coating, which can be made from the same materials with 1 1/2 pounds of lithophone added to each pound of vaseline. These two ingredients should be thoroughly mixed by stirring before adding the paraffin oil. In some cases, it is desirable to use a "slushing oil" which partially dries or sets. When this is done, the compound is made by mixing together 4 pounds of vaseline or No. 3 cup grease, 1 1/4 gallons of paraffin oil and 1/4 gallon of rosin oil.

Oakland, Cal. E. PERRY

MULTIPLE DRILLING FIXTURE

The fixture shown in the elevation section view, Fig. 1, is used for drilling four small holes simultaneously in the face of the brass casting shown by heavy dot-and-dash lines at *A*. The casting is machined, as shown by the finish marks, previous to the operation of drilling the four 0.072-inch holes in the upper face. The plan view, Fig. 2, shows the arrangement of the gear drive for the four spindles.

The base casting, upon which are mounted the various members of the fixture, is clamped to the table of a large sensitive drill press. On top of the base is fastened the gear-box casting *B*, which is held in alignment by the key *C*. The box *B* contains the gearing which drives the four spindles. The drill spindles are spaced radially about a common center, as shown. The spindle gears *D* are driven by the central helical gear *E*, which is part of the center spindle *F*. Spindle *F* is driven by the spindle of the drilling machine through the flexible coupling *G*, Fig. 1. The four drill spindles *H*, which are fitted with helical gears *D*, mesh with the central gear *E*, being staggered in order to avoid interference.

The steel top plate *K*, which is fastened to the gear spindle box *B* by machine screws, contains the gear spindle ball-thrust bearings *L* which take up the thrust of the drills. The lower plate *M* is hardened and ground, and fastened to box *B* by flathead screws. Each of the drill spindles *H* terminates in a threaded shank. Over the shank is fitted a knurled sleeve *N* which, when screwed on the shank, pushes up the tapered split chuck *O* against a corresponding tapered seat in the spindle. This action causes the split chuck to grip the drill *P* firmly.

As is evident from the illustration, the drills rotate but are not movable vertically, the work itself being fed up against them. This is done by means of shaft *Q* which is a slip fit in the sleeve *R*. Sleeve *R* is secured to the base of the angle casting by machine screws, being aligned with the drill press center by means of a shoulder. The rack *S*, cut in shaft *Q*, meshes with the spur gear *T*, which is

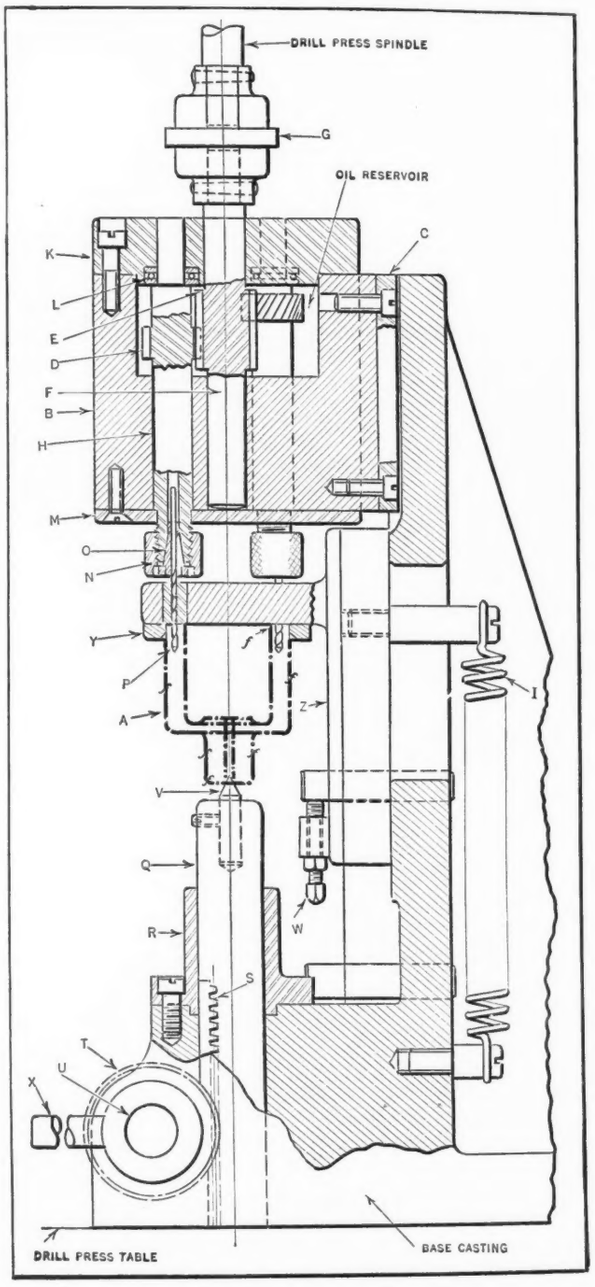


Fig. 1. Multiple-spindle Drilling Fixture

keyed to the pin *U*. Pin *U* is provided with a bearing in the base, as shown in the illustration. In the top of shaft *Q* is driven a pointed center *V*, which is held in place by a set-screw. A finished casting is placed in a vertical position over the spindle *Q* when the latter is in its lowest position. The center drilled in the lower end of the work will then rest on the center *V*.

The spindle *Q* is next made to rise by lowering handle *X*, which is pinned to the gearing shaft *U*. This causes gear *T* to rotate, thus forcing the rack

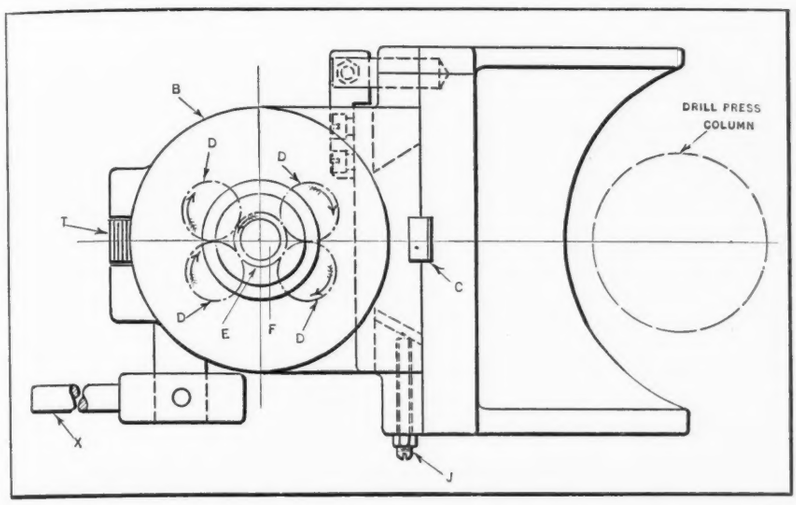


Fig. 2. Plan View of Gear and Spindle Arrangement of Fixture Shown in Fig. 1

S upward. As the vertical casting rises, it centers itself in the nest *Y*, fastened on the under side of the projecting shelf on the slide *Z*. This projecting shelf contains four properly located drill bushings which serve to guide the drills. As the face of the casting is advanced, it finally strikes the projecting shelf, causing the slide *Z* to rise against the pressure exerted by spring *I*. Slide *Z* travels in a dovetail groove machined in the angular base casting, as shown in the plan view, Fig. 2. A good fit for this slide is obtained by means of a gib which is adjusted by screws *J*. The adjusting screw *W*, Fig. 1, is set to strike the stop in slide *Z* and thus limit the travel of the slide, so that the holes are all drilled to their proper depth. The stud set in the base casting directly under the screw *W* limits the downward travel of slide *Z*, locating the slide in the proper position for removing the work.

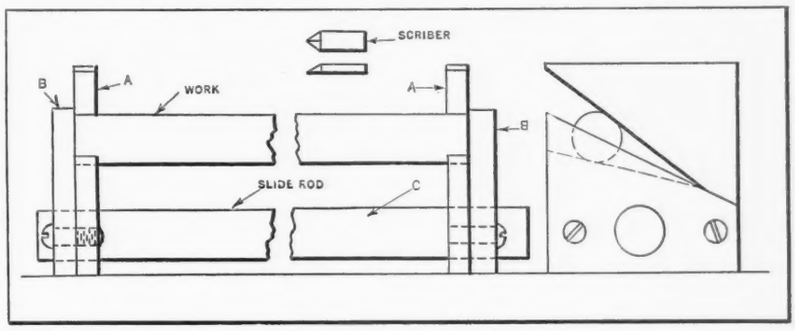
New York City — B. J. STERN

VEE REST FOR SCRIBING CENTER LINES ON ROD ENDS

The inclined vee fixture shown in the accompanying illustration enables a workman to quickly mark off the end centers of rods of any length and diameter within the capacity of the fixture. Referring to the illustration, the fixture consists of five essential parts, two vee blocks *A*, two flat scriber rests *B*, and the slide rod *C*. The vee pieces and the rests are held together by screws and are reamed out to a sliding fit on the rod *C*.

In use, the ends of the fixture are slid out or in as required to suit the length of the rod to be centered, and a flat scriber, such as shown in the illustration, is run along the face of the rest *B* for marking the center lines on the ends of the rod. The rod is then given a quarter turn and marked again, in order to secure crossed center lines. This fixture provides an inexpensive and efficient means for making centers preparatory to countersinking, and will prove very useful in small shops not equipped with centering machines.

Hamilton, Ont., Can. H. MOORE



Rod-centering Vee Rest

PAINT FOR OIL POCKETS OR RESERVOIRS

The interior pockets of many castings are used as reservoirs for lubricating oil for the finished machine. To keep the oil clean and free from particles of sand that might work into the bearings, these pockets should be sprayed or brushed with an oil-proof material to seal the pores of the iron. The interior of automobile transmission cases, for instance, is coated prior to assembling, in order to prevent foundry sand or other grit from finding its way into the bearings and gears.

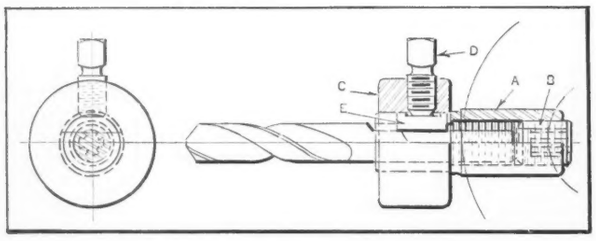
The painting may be done in the cleaning room that adjoins the foundry, before any shop work is started on the parts. A clear or transparent coat is not recommended, as it is difficult to determine if the coating is uniformly applied over the entire surface. Pyroxylin lacquer is adapted for this purpose, but does not adhere well if the iron or steel is oily or greasy. Automobile factories have used shellac very successfully, usually grinding in about two pounds of dry iron-oxide pigment per gallon of orange shellac. A white coating obtained by the addition of strong lithophone pigment to bleached shellac would be suitable for exposed pockets.

Oakland, Cal. — E. PERRY

POSITIVE-HOLD DRILL-HOLDER

A drill-holder for screw machines, intended for a special class of work, is here illustrated (see next page). Its purpose is to hold large drills on heavy work, where they have a tendency to slip and turn when held by friction, as is ordinarily done. This tendency of a drill is always troublesome, and often dangerous to the entire set-up because of the breakage of successive tools due to failure of a drill to complete its work. It is almost always better for the stock to be pushed back or the machine to stop than for a drill to fail to go to the proper depth.

With the holder shown, slippage of the drill in any direction is impossible. The holder consists of a shank *A* made with a hole which is a snug fit for the drill on the front end, while the rear end, for two-thirds the length of the holder, is threaded to receive the thrust screw *B*. A heavy collar *C* is a light force fit on the front end of shank *A*, and its



Positive Drill-holder for Screw Machine

set-screw *D* bears upon a segment *E* loosely fitting a slot formed crosswise of the shank and entering to a depth of about one-fifth the diameter of the hole. The shank of the drill is made with a corresponding flat, but extending a few thousandths inch above the level of the slot in the holder, thus causing the segment to grip the drill when the set-screw is tightened.

The three functions of holding the drill against rotation, slippage, and pulling out are therefore performed by three different and separate means. All of the thrust is taken by the rear screw, while the entire torsional stress is carried by the segment, and the set-screw merely serves to keep the drill from dropping or being pulled out. It is clear that slippage of the drill is not possible under these circumstances. On the other hand, an excellent positive adjustment for length is obtained by means of the thrust screw.

While it is true that no floating action is possible, it will be noted that the greater free length of the drill, together with the fact that the shank cannot be marred by accidental turning under stress of the cut, renders this of lesser importance. In general, it may be observed that modern small tools and machine tools are accurate to a degree which largely renders unnecessary such expedients as floating, provided a tool is held satisfactorily by its proper aligning surfaces, and in such a way as to prevent damage to those surfaces.

Jena, Germany — HENRY SIMON

BLANKING AND FORMING DIE FOR THIN DIAPHRAGM

At *A*, Fig. 1, is shown the plan view of a soft aluminum diaphragm 0.002 inch thick having a diameter of 2 1/8 inches. The cross-section *X–X* of one-half the diaphragm is shown to an enlarged scale. In Fig. 2 is shown the blanking and forming die in which the diaphragm is produced. The punch member consists essentially of a holder *A*, stripper *B*, rubber pad *C* for operating the stripper, guide pins *D*, blanking punch *E*, and a rubber forming punch *K*.

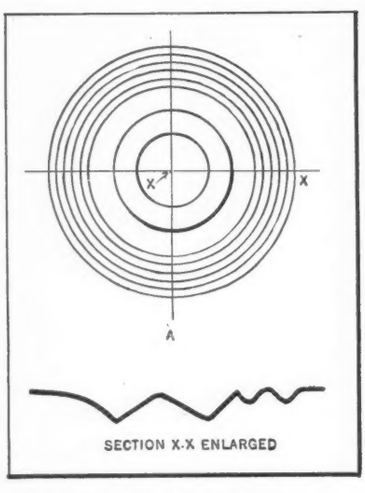


Fig. 1. Aluminum Diaphragm 0.002 Inch Thick

The die member is made up of the blanking die ring *F*, the die-shoe *G*, and the rubber pad *H* for operating the forming pad *I*. The punch *E* is of hardened and ground tool steel. The space *J* provides for the expansion of the rubber forming punch *K*. Small holes drilled through punch *E* allow the air to escape from the expansion chamber.

The stripper *B* is made of mild steel and is faced smooth on the under side. The blanking die *F*, located in the recess in the die-shoe, is made of tool steel and is hardened and ground. The hardened tool-steel forming pad *I* is held in place by a shoulder, over which the blanking die ring *F* is secured. The forming pad is backed up by the rubber pad *H*, which fits into recesses in the forming pad and the die-shoe. The space at *L* provides for the necessary travel of the forming pad *I*. Small holes, not shown, permit the air to escape from the chamber *M*.

When the die is in operation, the upper member, on its downward stroke, causes the rubber pad *K* to partly form the diaphragm and hold the stock in

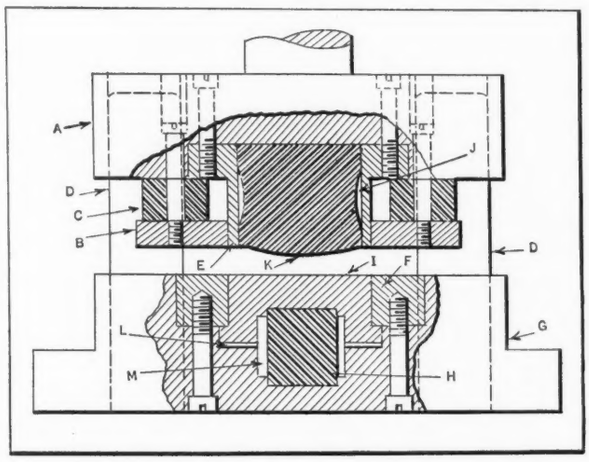


Fig. 2. Die Employed in the Production of the Diaphragm Shown in Fig. 1

place while punch *E* blanks the part. The downward movement is continued until pad *K* completes the forming operation. Before the die described was adopted for this work, a steel forming punch was employed. The steel punch was slightly distorted during the hardening operation, with the result that it frequently caused the diaphragms to break through at the sharp bends.

Clinton, Ia. — E. A. SISSON

CLEANING TRACINGS WITH GASOLINE

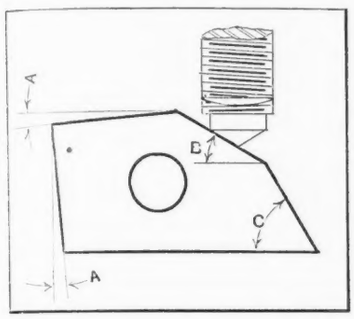
Tracing cloth can be easily cleaned with gasoline. When the tracing is finished and all inking is completed, soak a small piece of cheesecloth with gasoline and with this, remove all pencil lines, rubbing the tracing lightly. Next rub over both sides of the tracing using a clean portion of the cheesecloth. This will remove all dust and dirt, which is bound to accumulate more or less on tracings. After this has been done, take a second piece of cheesecloth, which must be clean and dry, and remove the gasoline. Always be sure to remove the gasoline, because it will soften the ink if allowed to remain on the tracing. It will be found that blueprints made from tracings treated in this manner are very clear.

Chicago, Ill. — RAY KRENGEL

Shop and Drafting-room Kinks

DRAFTSMAN'S TEMPLET

The templet shown in the accompanying illustration will be found useful when drawing threads and various other details. The templet may be made from any suitable material, a transparent material being preferable. Angle *A* is approximately 4 degrees; angle *B*, 30 degrees; and angle *C*, 60 degrees. The hole in the center of the templet permits it to be hung up when not in use.

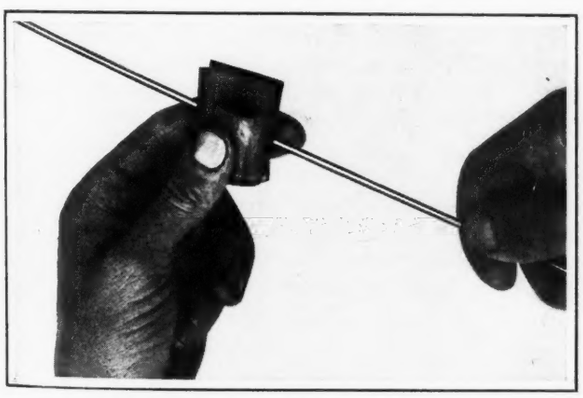


Draftsman's Templet

Bridgeport, Conn. A. H. PONELEIT

CLEANING AND POLISHING WIRE

The discomfort caused by gripping and holding emery cloth with the fingers when polishing and cleaning wire may be greatly lessened by using a holder for the emery cloth, as shown in the accompanying illustration. The holder is simply a cork with a slot cut in one end to receive the piece of folded emery cloth. This gives the fingers something to grip, which they can easily compress to obtain the required abrasive action when the emery cloth is worked over the wire. The holder can be held at different angles to insure a thorough job of cleaning and polishing. The writer found this to be a handy kink when cleaning steel wire from which springs were to be made. F. W. B.



Method of Cleaning and Polishing Wire

SCALE INDICATOR FOR TRIANGULAR RULE

The triangular form of rule provided with either engineer's or architect's scales is employed by most draftsmen. To make sure of laying out the entire plan with the same scale, requires constant vigilance. An ordinary advertising button clip, attached to one edge of the scale so that the button part always faces the scale when in use, will automatically insure using the correct scale and also provide a convenient means of picking up the rule.

Philadelphia, Pa. J. F. HARDECKER

"SAFETY FIRST" WITH THE CHISEL

A chisel is a mean thing to handle when working out in the cold, as a light glove is about all that can be safely used to cover the hand, which, although it may not be chilled to great discomfort, is nevertheless not able to hold and grip the chisel firmly. By wrapping the chisel with several turns of rubber, such as may be cut from an old inner tube of an automobile tire, and tying this firmly in place, a better grip for the hand is provided.

F. W. B.

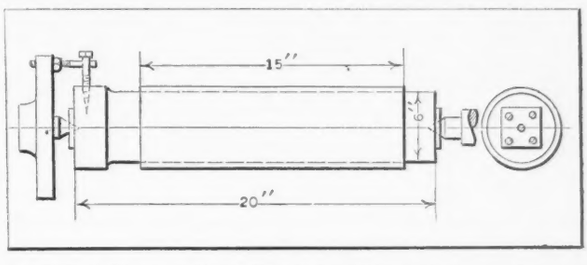
Chisel with Rubber Grip

WOODEN MANDREL FOR LARGE LATHE WORK

In some shops, there are jobs that require large heavy mandrels for turning large bushings, pump liners, and similar work. When these are made of steel or cast iron, they are heavy and awkward to handle.

A mandrel of the dimensions shown in the accompanying illustration, when made of cast iron or steel, would weigh nearly 150 pounds. Made of hard maple, it would weigh about 25 pounds. If steel plates or plugs are screwed on at the ends for center bearings, a mandrel of this kind will produce as accurate results as a metal mandrel. It will also speed up the work and will not fatigue the mechanic as quickly, especially when he has to handle the work frequently. Such mandrels are also valuable in the jobbing shop where occasional jobs with big bores come in.

Syracuse, N. Y. H. L. WHEELER



Mandrel Made of Hard Wood for Jobs with Large Bores

Questions and Answers

NOTICE OF DEFECTIVE MACHINERY

M. L. E.—A manufacturing company purchased machinery under a written contract which provided for thirty days trial by the buyer. This contract also stipulated that unless complaint of defects was made before the expiration of thirty days, the buyer would be deemed to have accepted the machinery and would be liable for the purchase price. The buyer discovered defects, but did not notify the seller of this until after the expiration of thirty days. Is the buyer liable for the price of the machinery?

Answered by Leslie Childs, Attorney at Law, Indianapolis, Ind.

Contracts of this character are valid, and if fairly entered into will be enforced. The parties had the right to agree that silence on the part of the buyer during the thirty-day trial period should constitute an acceptance of the machinery. It follows that, unless the buyer can show bad faith, fraud, or sharp practice on the part of the seller in relation to the transaction he will probably be held liable. (215 Pac. 60).

TREATMENT FOR TIN ARTICLES

N. B. I.—I want to find out how a metal product, consisting of several tin parts, may be dipped in hot oil, so that the tin will flow and fill up all cracks and seams. What kind of oil is used, and to what temperature must it be heated? Should the parts be dipped in a cleaning solution prior to the oil dip? How are the parts cleaned after the oil dip?

Answered by A. Eyles

It may be assumed that the parts are made of tin plate rather than from tin as stated in the question. Dipping and cleansing equipment for coating metal products usually consists of acid containers, tinning or dipping baths, water tanks and drying receptacles. The first and one of the most important steps in filling up cracks and seams in metal articles by immersion in molten tin, is thorough cleaning of the areas near the crevices. Unless this is done successful results cannot be obtained. This cleansing can be done by a hot solution of sulphuric acid and water, or a cold solution of muriatic acid and water.

While the muriatic acid solution costs more, it is stronger and safer to use. Unless the fumes are mechanically removed, they will attack or corrode machinery and other tools in the plant. After being thoroughly cleaned the articles should be rinsed in clean water. If the tin dipping bath is not quite ready, the cleaned articles may be preserved from oxidization for some time by immersing them in clean water or a bath containing one part muriatic acid to ten parts water.

When dipping the articles in molten grease (palm oil) and tin to fill up the crevices, it is essential to prevent the articles from becoming too hot. Also, great care must be taken not to overheat the molten tin; the temperature should be maintained just above 450 degrees F. which is the melting point of tin. Undue heating will spoil the surface appearance of the articles, and accelerate the formation of slag or dross.

The articles should be heated in the palm oil bath to a temperature slightly above the melting point of tin. This temperature should be constantly and uniformly maintained.

On completion of the tinning process, the parts should be scoured in clean water with a wad of waste and a little whiting, and finally washed off and dried in warm clean sawdust. If an attractive luster or gloss is required on the coated areas they should be cleaned with bran and polished with chamois leather or sheepskin.

DIAMETER OF ROLLED MATERIAL

O. G. S.—Is there a rule or formula for determining the outside diameter of a roll of material such as cloth, belting, etc., when only the length and thickness are known?

A.—When the length and thickness are known, the approximate diameter of the material after rolling may be determined, but if the material is soft and yielding there may, of course, be considerable difference between the actual and the calculated diameters because the size of the roll would be affected by the tightness of the winding. An error from this cause would, of course, be more likely to occur with cloth than with, say, leather belting.

Ordinarily, a roll of material would have a hole at the center. Now if D_1 equals the diameter of the hole at the center or of the roll upon which the material is wound, L equals length of material, and t equals thickness of material, then

$$L = D_1 \times \pi + (D_1 + 2t)\ \pi + (D_1 + 4t)\ \pi + \text{etc.}$$

Thus we have an arithmetical progression in which there is a common difference (d) represented by $2t\pi$. $D_1 \times \pi$ equals the first term (a); the sum (S) of the number of terms equals L or the total length of the material.

The problem is to determine the last term in the progression, because this equals the circumference of the last turn of the material. When the three values a, d, and S are known, the value of the last term (l) in the progression may be determined by the equation given on page 102 of the sixth revised edition of MACHINERY'S HANDBOOK. Thus,

$$l = -\frac{d}{2} + \frac{1}{2}\sqrt{8dS + (2a - d)^2}$$

After finding the value of l, which equals, in this case, the circumference of the last turn, the outside diameter of the roll equals, of course, $l \div \pi$. It will be noted that in the preceding formula a represents $D_1 \times \pi$, but if there were no inside roll or hole, then a would be merely $2t\pi$.

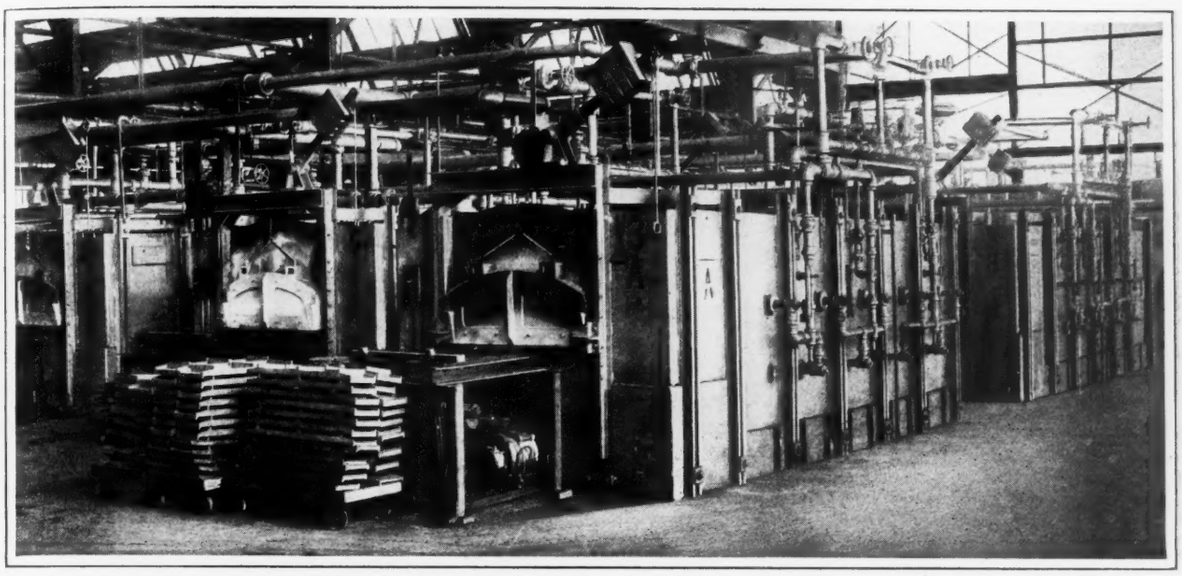


Fig. 1. Furnaces Arranged in Tandem for Hardening and Tempering or Normalizing, Hardening and Tempering, in Immediate Sequence

Willys-Overland Heat-treating Methods

Normalizing, Hardening and Tempering Operations Performed by Automatically Carrying the Work through Furnaces Arranged in Tandem

By F. W. MANKER, Vice-president, The Surface Combustion Co., Toledo, Ohio

GAS-FIRED furnaces, arranged in tandem with a quenching tank between, are employed in the new heat-treating department of the Willys-Overland Co., Toledo, Ohio, for hardening and tempering various parts. The work is automatically pushed through the hardening furnace and carried through the quenching tank. Then an attendant places the work on an extended hearth of the tempering furnace, and it is carried automatically through this furnace.

Certain parts are normalized prior to hardening, in a furnace placed ahead of the hardening furnace. In such installations, the work is not touched by hand from the time it is placed on the hearth of the normalizing furnace until it is delivered to the tempering furnace by the conveyor of the quenching tank. All the heat-treating equipment in this new department was built by the Surface Combustion Co., Toledo, Ohio.

Hardening and Tempering Crankshafts

When the crankshafts are received in the heat-treating department, they are first snagged on floor grinders and then delivered to a hardening furnace.

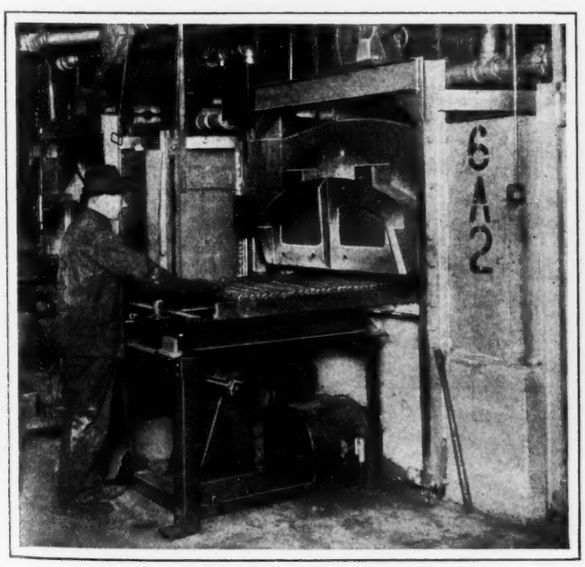


Fig. 2. Loading a Furnace Equipped with a Mechanical Pusher for Automatically Carrying the Work through the Furnace

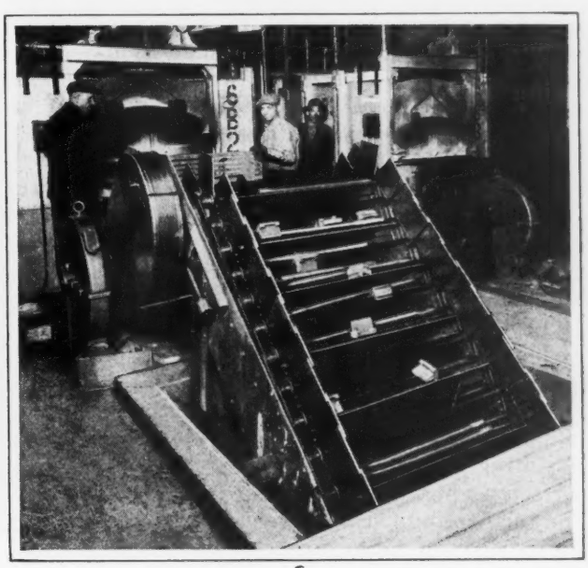


Fig. 3. Conveyor which Carries Hardened Parts Automatically from the Quenching Tank to the Tempering Furnace

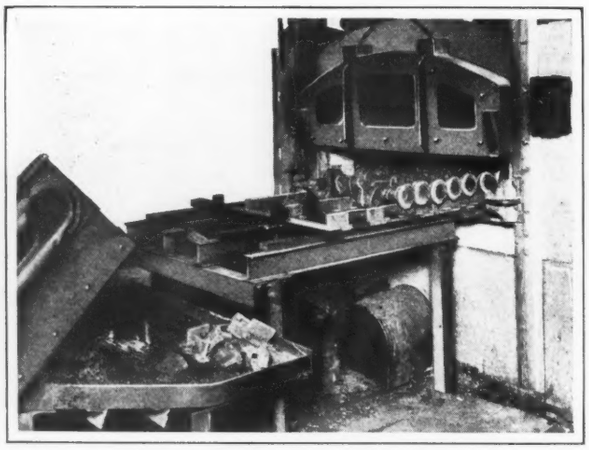


Fig. 4. Loading End of the Crankshaft Tempering Furnace, with the Pusher Bar Exerting Pressure against the "Nichrome" Shoes

The hearth of this furnace supports alloy steel rails, which extend 5 feet in front of the furnace, as illustrated in Fig. 2. Alloy-steel channel-type shoes are placed on these rails, and the crankshafts are laid on the shoes. A pusher mechanism, similar in design to that seen in the illustration, oscillates back and forth, and by exerting pressure on the front shoe of each row, pushes all the shoes and their crankshafts through the furnace at an intermittent rate. This hardening furnace is 27 feet long, 9 feet wide, and 6 feet high.

At the discharge end of the hardening furnace, the shoes and crankshafts drop off the skid rails into a quenching tank filled with water. A covered chute extends from the top of the furnace down into the water to prevent cold air from getting into the furnace and also to keep out oxygen, as a reducing atmosphere is maintained.

The quenching tank is made of steel, and is about 12 feet long, 9 feet wide, and 6 feet deep. It is equipped with an elevator conveyor, such as shown in Fig. 3, on which the shoes and work drop and are carried by the conveyor to a table in front of the tempering furnace. Here, an operator places the shoes and crankshafts on the skid rails of the tempering furnace, and they are carried through this furnace by a mechanical pusher, as may be seen in Fig. 4. The tempering furnace is like the hardening furnace, except that it is 2 feet longer and the hearth extends 4 feet instead of 5 feet beyond the front end.

Both the hardening and tempering furnaces are built of firebrick, suitably insulated and steel encased. The hardening furnace is equipped with fifteen gas burners and five inspirators on each side, while the tempering furnace has twelve burners and four inspirators on each side. The inspirators are of the Venturi automatic proportioning type, and mix the air and gas for any furnace atmosphere desired—reducing, oxidizing, or neutral. For hardening, a heat of 1600 degrees F. is maintained, and a heating period of sixty minutes is allowed, while for tempering, the temperature is 1220 degrees F., and the heating period, seventy minutes. The heating periods of both furnaces are, of course, controlled by the mechanical pushers. These pushers are driven by motors through cam and link mechanisms, and are timed by Stromberg clocks.

At the discharge end of the tempering furnace, which is shown in Fig. 5, an operator picks up the crankshafts with tongs and hangs them on an overhead chain conveyor by which they are carried to the pickling room. The same operator drops the shoes into warp-proof containers to be returned to the charging end of the hardening furnace.

Heat-treating Miscellaneous Parts

Over 200 miscellaneous parts, such as steering knuckles, connecting-rods, spring shackles, and eccentric shafts, are hardened and tempered in three similar batteries of furnaces. The dimensions of these furnaces are somewhat different, however, the hardening furnace being 21 1/2 feet long, 8 feet wide, and 9 feet high, while the tempering furnaces are of the same width and height but 24 feet long. These furnaces are equipped with ten burners and five inspirators on each side.

The work is placed on "Nichrome" trays, which are carried through the hardening furnaces by mechanical pushers in the manner already described. When these trays reach the far end of the furnace, the work is automatically dumped into the quenching tank, while the trays are removed by the operator through a door. Tongs are employed for this purpose, and the trays are placed in a tote box to be returned to the charging end of the furnace. The operator also places other trays on the charging table of the tempering furnace, and as the conveyor from the quenching tank dumps the parts on this table, he loads them on the trays to be carried through the tempering furnace. These hardening and tempering furnaces are maintained at 1540 degrees F. and 1150 degrees F., respectively, while the heating period in the former is seventy-five minutes, and in the latter, eighty minutes.

Three Furnaces Used in Heat-treating Rear Axle Shafts

Rear axle shafts are normalized prior to hardening and tempering, in a furnace placed 6 feet ahead of the hardening furnace. The skid rails extend through both furnaces and bridge the gap, so that one mechanical pusher serves to carry the work through both units. The 6-foot gap allows the

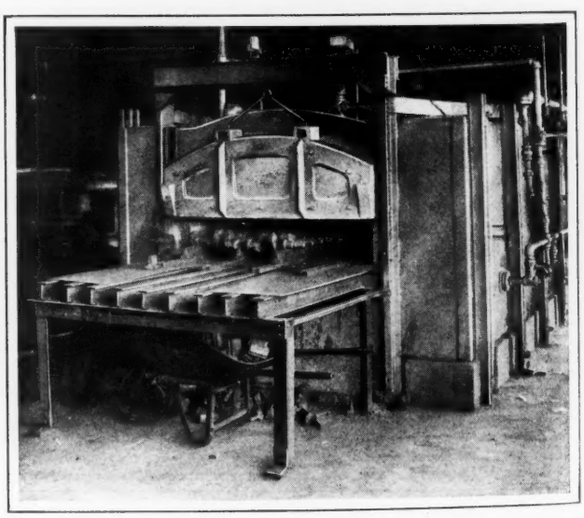


Fig. 5. Crankshaft Tempering Furnace from the Discharge End

work to cool sufficiently before entering the hardening furnace.

The work is charged into the normalizing furnace on "Nichrome" shoes, as shown in Fig. 2, and both the work and shoes are discharged into the quenching tank through a chute at the unloading end of the hardening furnace, in the manner described in connection with the crankshafts. The conveyor illustrated in Fig. 3 lifts the shafts and drops them on the loading table of the tempering furnace. Again, an operator places the shafts and shoes on the skid rails in front of the tempering furnace pusher. At the discharge end of this furnace an operator puts the shafts into a warp-proof container, and they are transferred to a grinder, while at the same time he dumps the shoes into another conveyor which carries them back to the charging end of the normalizing furnace.

The normalizing furnace is maintained at a temperature of 1625 degrees F., and the heating period is fifty minutes. The work is heated to 1600 degrees F. for sixty minutes in the hardening furnace, and to 1100 degrees F. for the same period in the tempering furnace. The normalizing furnace is 18 1/2 feet long; the hardening unit 20 feet, and the tempering unit 26 1/2 feet. In cross-section the furnaces are all 8 feet wide by 6 1/2 feet high. Each furnace has nine burners and three inspirators on a side.

Annealing Operations Performed in Pusher-type Furnaces

After being formed under hammers, many parts must be annealed, so that the flash can be trimmed cold without causing excess wear of the trimming dies. Other parts are annealed for different purposes. Annealing operations in this plant are performed in two furnaces, both 26 1/2 feet long, 8 1/2 feet wide, and 6 1/2 feet high, which are also equipped with mechanical pushers for automatically carrying the work through the process. A temperature of 1650 degrees F. is maintained in these furnaces, and the heating period is ninety minutes.

All furnaces mentioned in this article are equipped with automatic temperature control instruments of the recording type. These instruments are located in a central room where the action of each furnace can be easily observed by the chief metallurgist.

* * *

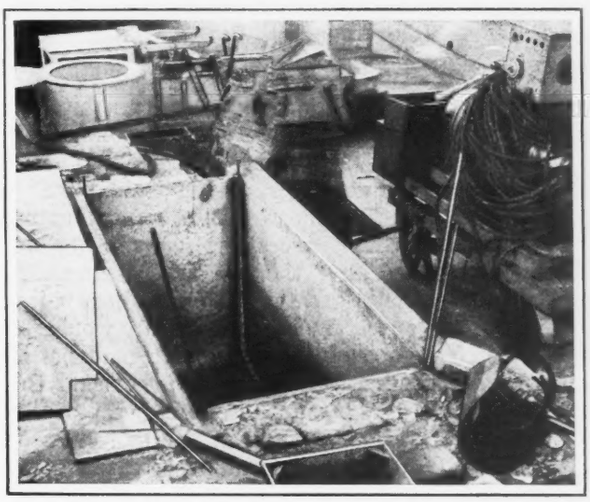
INDIANAPOLIS FOREMAN TRAINING COURSE

To develop and direct a systematic program of foreman training through regular foreman conferences in the plants of the Indianapolis members of the National Metal Trades Association and other interested metal trades shops, a three weeks' course of daily classes each afternoon, for a period of two and one-half hours, will begin October 15. These classes will be conducted under the joint auspices of the committees on industrial education of the national organization and the Indianapolis branch. No cost is attached to participation in these classes, and all Indianapolis companies in the metal trades having eight or more foremen and department heads are being invited to participate.

REPAIRING GALVANIZING TANK BY ARC WELDING

Galvanizing tanks require a considerable amount of repair work and frequent replacement owing to the destructive effect of the hot zinc. Past methods of making repairs have been unsatisfactory and the cost of replacement has been and still is high. In the accompanying illustration is shown one of the smaller tanks in the galvanizing section of the East Pittsburgh Works of the Westinghouse Electric & Mfg. Co. It is constructed of 1 1/2-inch boiler plates fastened together by heavy rivets. After this tank had been in service for some time, a leak developed in a riveted seam, and it was necessary to discontinue its use. It was then discovered that the hot zinc had eaten into the bottom of the tank in several places.

It was decided to repair the tank by arc welding, because this method permitted all the work to be



Galvanizing Tank Repaired by Arc Welding

done on the inside of the tank, thus making it unnecessary to tear out the foundations and the combustion chamber, which would involve considerable expense. All the thin portions were built up to the correct thickness by arc welding so that the plates were practically as good as new. A 3/4-inch steel rod was then laid in each seam and welded solidly to the metal on each side, as shown in the illustration. The ends of the rods were cut off and carefully covered with beads of welding to give a smooth corner.

The success of this repair work and the advantage of arc welding over riveting were so obvious that all future galvanizing tanks installed by the company will be of the arc-welded type.

* * *

VALVE FOR CHROMIUM-PLATING SERVICE

A device designed for controlling the temperature of chromium-plating tanks has recently been brought out by the St. Louis Motor Valve Co., St. Louis, Mo. This device is driven by a special General Electric totally enclosed reversible motor which drives a threaded shaft through a double worm-gear reduction mechanism. A lever connected to this shaft and pivoted in its center operates two valves alternately, one for steam and one for water. The motor is stopped by a limit switch.

Notes and Comment on Engineering Topics

The New York Edison Co. has just ordered steam generating units for supplying the steam to drive the largest single-shaft single-unit electric generator so far built anywhere in the world. The turbo-generator will develop 160,000 kilowatts (approximately 215,000 horsepower). The generating station where this equipment will be installed will contain the largest pumping station in the world. The total capacity of the circulating pumps will be 1,400,000 gallons of water a minute, which is double the quantity of water used by the entire city of New York from its water supply. The water pumped is not city water, but is taken from the East River for steam condensing purposes, and all the water used is returned to the river.

Air spaces for insulation purposes, built into the walls of boilers, furnaces, etc., do not fulfill their designed function at high temperatures, say Messrs. Ray and Kreisinger, of the United States Bureau of Mines. As the result of an exhaustive series of tests, with air spaces serving as insulation, it was established that the hot surfaces radiate heat so rapidly that a greater amount of heat is lost across the air space by radiation than would be conducted if the space were filled with material of relative high conductivity, such as firebrick. Besides the intense radiation, there is also rapid convection. The average velocity of the molecules of the air, at 1100 degrees F., is approximately sixty miles a minute. The term "dead air space," as it is sometimes called in this connection, is, therefore, a misnomer: more properly it should be spoken of as "live air space."

The Bureau of Labor Statistics of the United States Department of Labor has made a comparison of wages in various occupations in a number of different countries of Europe and the United States. From this comparison it appears that heaters in the rolling mill industry, for example, receive from $1.81 to $4.57 in Germany, an average of $4.36 in Great Britain, and $7.60 in the United States. Common laborers in rolling mills receive from $1.40 to $2.07 in Germany, from $1.61 to $1.64 in Great Britain, and an average $3.28 in the United States. An interesting comparison is also made between wages and the cost of living, and it is pointed out that while prices have risen along with wages, they have not risen as fast as hourly wages, and that in 1926, for the wages obtained in 1 hour, the average worker could buy 30 per cent more than he could in 1913.

Recent developments made by builders indicate that the general shape and arrangement of the future motorcoach is to be considerably changed from the present conventional form. The tendency seems to be toward the form of a street car with pneumatic tires, placing the engine elsewhere than at the front, asserts A. T. Atwell, of the Westinghouse Electric & Mfg. Co., in the *S.A.E. Journal*. The electric drive will, no doubt, be an important factor in working out the most suitable arrangement, because of the greater freedom it gives in the location of the engine. Other advantages claimed for the gas-electric bus are rapid and smooth acceleration, and a saving of time otherwise absorbed in changing gears; on the other hand, fuel consumption with this type of bus is 10 to 20 per cent greater than with the bus using mechanical drive. In spite of this fact, the largest users of gas-electric buses are buying an increased number of vehicles of this type.

The constant advance of oil engine propulsion for ocean-going ships is indicated by the fact that of the 272 ocean-going vessels under construction on June 30 this year, according to Lloyd's register, not less than seventy-five were oil-engine-driven. The tonnage of such ships under construction in Great Britain and Ireland is 546,826, while those built in other countries reached a figure of over 953,000 tons, which is nearly double the tonnage of all steamers built in countries outside of Great Britain and Ireland. It is particularly noteworthy that in large sized ocean-going vessels the oil-engined ship predominates. There are eighty-six vessels, in all, of 8000 tons and larger, under construction. Of these, sixty-five will be provided with oil engines. The total horsepower of all ocean-going ships being built at the present time is 1,960,000. Of this, oil engines account for 1,253,000 horsepower, or nearly double the sum of the turbine and steam reciprocating engines combined.

Until a few years ago, when a large bell of historic interest cracked through constant use, there were only two alternatives—that of sending it to a local museum or of remelting it—because it was considered almost impossible to repair the damage, as the results of such repairs always proved unsatisfactory. The remelting of the bell practically destroyed all the historic interest that attached to the original work. During recent years, however, bells have been repaired by electric welding with very satisfactory results. One such instance is reported from England, where a bell, the seventh of a peal of twelve belonging to a church in Ipswich, which was made in 1607, has been electrically welded, using welding metal as nearly as possible of the same composition as the bell itself. The selection of the welding material is an important factor in the success of such repairs. The question naturally arises as to the permanency of such repairs. It is mentioned in *Engineering* that some bells of a church in Norfolk, England, dated 1568, were repaired by electric welding three years ago and have been in satisfactory use ever since.

A Successful New England Apprentice Plan

A REGIONAL meeting of the American Society of Mechanical Engineers, known as "The New England Industries Meeting," will be held in Boston, October 1 to 3. The program for this meeting covers a varied field applied to New England industries. Technical sessions will be held on education and training for the industries, materials handling, aeronautics, applied mechanics, management, railroad operation, power, mechanical handling of lumber, and machine shop practice.

Apprenticeship at the Lynn Plant of the General Electric Co.

Charles K. Tripp, supervisor of apprentices at the General Electric Co.'s plant at Lynn, Mass., will read a paper on the system of training that was inaugurated at this plant in 1902 and that has been in successful operation ever since. The purpose of this system is to train future superintendents, foremen, and designers, as well as to develop good workmen. With this in mind, the company has equipped a machine shop at the Lynn Works especially as a training room, and has also provided classrooms where apprentices receive a technical education. At present, the training shop for machinist apprentices occupies the top floor of a modern factory building, which covers an area of 12,000 square feet and is equipped with the most modern machinery.

There are four major courses: Machine shop work, drafting, patternmaking, and molding. All the courses are on a four-year basis. In all the courses, the boys are supervised by experienced instructors. There are twelve of these instructors in the machinists' shop course, seven of whom are themselves graduates of the Lynn apprentice course; the other five are journeymen machinists selected for their production ability and their capacity for teaching. Each instructor has from fifteen to twenty apprentices under his supervision.

The training shop produces commercial work, and all the apparatus made in the apprentice shop is subjected to the most rigid inspection by the general inspection department of the plant, as it must of necessity be of equal quality to that produced by any other department. The amount of rejected work is very small—less than 2 per cent.

The Apprentice Course Always has a Waiting List of Applicants

The proper selection of the apprentice is a matter of the greatest importance. Fortunately, the Lynn Works have more applicants than can be accommodated, and there has been no need to advertise for apprentices. A large percentage of those who apply are relatives or friends of present or former apprentices. The quality of those applying is also improving constantly. Twenty-five years ago a high-school graduate rarely made out a machinist-apprentice application, but today 75 per cent of the apprentices are high-school graduates.

Each year, close to 250 apprentices are selected and hired, but of these, about fifty are dropped during the first year because they are unable to maintain the classroom standard, and thirty are dropped because they are unable to maintain the shop work standard. One-third of the latter, however, have been employed as regular workmen in other departments of the plant. In addition, some seventy boys leave during the course for various reasons—to return to school, because of illness, etc.—leaving approximately 100 boys that complete the course each year.

Characteristics Sought for in Selecting Apprentices

Personal appearance is the first factor considered in making a selection; next come personality and character. It is further necessary to find out, if possible, if the boy has an aptitude for the trade he wishes to learn. Certain aptitude tests aid in determining the boy's ability for any particular trade, but the judgment of the man selecting the boy has a strong influence in arriving at a decision.

There is, however, no test that will determine to satisfaction whether the individual has such important characteristics as character, judgment, initiative, application, energy, and stability. Sometimes it will take only a few days of actual work in the shop to bring out the presence or lack of these characteristics; sometimes it may take several months. Therefore, the apprentice is actually on probation for the full term of his apprenticeship.

The Classroom Work Covers a Wide Field

The classrooms occupy a floor space of 5000 square feet; they are so arranged as to accommodate thirty apprentices each, and are equipped for teaching the different subjects that are taken up. Classroom instructors are selected not alone for their ability to teach their respective subjects, but also because of their practical experience and personality. The classroom work is divided into two sections—the engineering school and the apprentice school. The engineering school is open to high-school graduates who can successfully pass entrance examinations in mathematics and elementary mechanics. The apprentice school is maintained for high-school graduates who cannot pass the engineering school entrance examinations and for grammar school graduates, but the applicant for this school must also pass an entrance examination in arithmetic.

What the Lynn Apprentice School has Accomplished

Since the beginning, 1070 young men have graduated from the Lynn apprentice course. Of these, 550 are still with the General Electric Co., many occupying important positions. Two are managers; five are superintendents; twenty-two, engineers; twenty, foremen; thirty-three, assistant foremen; nine, sub-foremen; and ten are employed in the time study and cost departments. Not less than

forty of the apprentice graduates are salesmen. Of those who are not still with the General Electric Co., forty are teaching in trade schools and colleges and a large percentage are holding executive and engineering positions in nearly every state in the country and in several countries abroad.

Selecting Apprentices by the Aid of Tests

In a paper entitled "Experience in the Selection of Apprentices with the Aid of Tests," Walter S. Berry, Director of Training, Scovill Mfg. Co., Waterbury, Conn., outlined the results obtained by the use of special tests to which apprentices are subjected before hiring. After these tests had been instituted, the men under whom the apprentices were working in the shop began remarking that they were not getting any more hopeless apprentices. According to Mr. Berry, since his company began the selection of apprentices by the aid of tests, it has been possible to eliminate 18 per cent of the total failures and to raise the percentage of those successful about 8 per cent. (For a brief description of the tests, see "A Study of American Intelligence," by C. C. Brigham, published by the Princeton University Press).

Machine Shop Practice Session at the New England Industries Meeting

The machine shop practice session will feature a symposium of papers on machine shop work for textile mills. A paper on "Developments in Internal Grinding" will also be read by Alden M. Drake, chief engineer of the Greenfield Tap & Die Corporation, Greenfield, Mass. In this paper a concise historical review of the progress of the development of internal grinding machines will be given, beginning with the first machines brought out in the early nineties for the bicycle industry, and following the progress up to the present time.

* * *

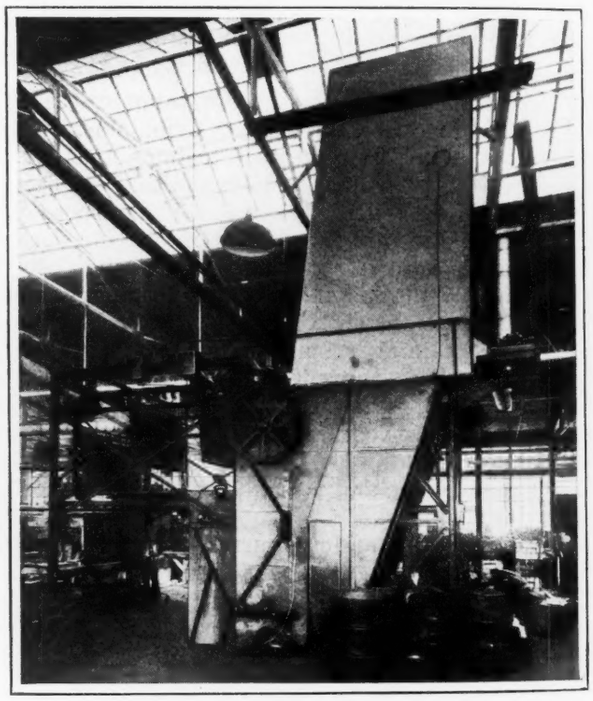
AUTOMOBILE STEERING COLUMNS ENAMELED IN AN AUTOMATIC OVEN

Automobile steering columns are automatically dipped in enamel, drained, and baked in an electrical oven recently installed at the plant of the Gemmer Mfg. Co., Detroit, Mich. This oven is provided with a conveyor which is loaded at intervals with cross-rods holding about fifty steering columns vertically, as may be seen at the left in the illustration. After the columns leave the loading position, they are dipped into a tank containing enamel. Then they drain for twenty minutes as they are carried to the oven proper and are baked for forty-five minutes while being carried through the oven. The entire cycle consumes ninety minutes, which results in a production of approximately 500 columns per hour.

One of the features of this enameling equipment, in addition to the high production obtained, is the comparatively small amount of floor space occupied. From the dipping tank, the conveyor ascends to the oven at an angle of 70 degrees, which gives an unusually compact equipment. The entire installation occupies a floor space of only 8 by 15 feet.

The oven itself is in the form of an inverted U, and the top is insulated with a 4-inch layer of rock wool. Heat is supplied by General Electric units, and the fumes are drawn off by a small fan on one side. The heat flows in a direction counter to the movement of the work through the oven, with the result that the finished work is cooled by the intake air while the incoming work is brought up to temperature by what would otherwise be waste heat. The baking heat is reached at the apex of the oven. The insulation is such that the temperature of the oven in the morning after sixteen hours of idleness is usually about 200 degrees F.; the normal baking temperature is about 500 degrees F.

In commencing to use the equipment in the morning, the heat is turned on when the conveyor is started and by the time the first cross-rod of work reaches the oven, it has attained the desired



Enameling Oven in which Automobile Steering Columns are Automatically Dipped, Drained, and Baked

temperature. Thus, in a nine-hour day, the equipment functions for approximately 8 hours and 35 minutes. The dipping tank and oven are enclosed in a sheet-metal housing, and as the work goes into the equipment dry and comes out in a similar condition, there is no necessity of performing the operation in a dustproof room, which was the case when the steering columns were enameled under the methods previously employed. Automatic control of the oven temperature results in uniformity of the product.

Cross-bars loaded with the steering columns can be attached to the conveyor every few inches, but they must be so spaced that the columns clear each other in their progress through the enameling operation. However, the means provided for attaching the cross-bars to the conveyor permit the spacing of the cross-bars to be altered to suit columns of different lengths. The cross-bars are removed from the conveyor for reloading.

This continuous-conveyor enameling equipment was built by the Kirk & Blum Mfg. Co., Cincinnati, Ohio.

Machine Tools in Modern Industry

THE Machine Shop Practice Division of the American Society of Mechanical Engineers, meeting under the auspices of the Cincinnati Section and cooperating with the Machine Tool Congress, held a number of sessions in Cincinnati, Ohio, September 24 to 27, at which papers of interest to the machine shop engineer were read and discussed. The meeting was held partly at the Hotel Sinton and partly on the river steamer *Cincinnati* by which those participating in the meeting visited Ashland, Ky., for the purpose of inspecting the continuous sheet-mill plant of the American Rolling Mill Co. The technical sessions included a symposium on the use and application of machine tools in modern manufacturing plants; machine shop practice in airplane engine plants; and lubrication of bearings.

In the aeronautic machine shop practice meeting, papers were read by R. W. Daniels of the Baush Machine Tool Co., Springfield, Mass., and H. W. Roughley of the Wright Aeronautical Corporation, Paterson, N. J. Two papers were read at the lubrication meeting—"Theories of Bearing Lubrication," by Forrest E. Cardullo, chief engineer of the G. A. Gray Co., Cincinnati, Ohio, and "Grooving Bearings for Machine Tools," by G. B. Karelitz of the Research Department, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

The application of machine tools in modern manufacturing plants was dealt with in four papers. The automotive industry was discussed by L. L. Roberts, mechanical superintendent, Packard Motor Car Co., Detroit, Mich.; the electrical industry, by J. R. Weaver, superintendent of manufacturing equipment, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.; the agricultural implement industry, by Max Sklovsky, chief engineer, Deere & Co., Moline, Ill.; and the railroad field, by L. A. North, shop superintendent, Illinois Central Railroad, Chicago, Ill.

The Increasing Use of Welded Machine Frames

In his paper on practice in the electrical industry, Mr. Weaver called attention to the fact that in this field welded fabricated steel construction work is becoming quite generally used for machine frames and parts. This reduces the machining time considerably, and it was suggested that possibly the same methods might be applied in building machine tools. In the construction of jigs and fixtures, this method of building up, by welding, frames that were formerly cast, has been used very extensively and has not only reduced cost, but has made it possible to complete jigs and fixtures in three weeks less time than formerly. This saving in time is due to the fact that it would take about three weeks to obtain a pattern and casting.

Improvements Made in Cutting Tools

Mr. Weaver also referred to experiments undertaken at the Westinghouse plant with a special alloy steel by means of which it has been found possible to increase cutting speeds on certain operations as much as 250 per cent and still obtain good results. Should this steel prove suitable for general machining purposes, it would mean that machine tools would have to be built to run at much higher speeds than are now customary.

It was also mentioned that quite extensive experiments had been made with chromium plating of cutting tools. On materials other than metals, success has been obtained with this process, but when cutting steel and cast iron, it has been found that the plating chips off at the cutting edge, and then the cutting tool gives no better results than an ordinary unplated tool.

Grinding in the Railroad Shop

In his paper "Machine Tools—Their Use and Application in the Railroad Industry," Mr. North particularly emphasized the increasing field for external and internal grinding in the railroad shops. The grinding process has made it possible to reduce costs in the railroad shops to a considerable extent. Because of the small amount removed by grinding, it has also been found possible to add to the life of parts that have to be reconditioned from time to time. This applies to such parts as piston-rods, pump and air cylinders, crankpins, and driving axles.

As an example, it was mentioned that a piston-rod having a length over all of 77 inches, with a large diameter of 4 1/8 inches on the cylinder end, the extension-end diameter being 3 inches, was finished by grinding in 58 minutes, with a diameter reduction of from 0.030 to 0.060 inch. Formerly, this operation had required 2 hours 45 minutes.

Internal grinding has also proved of great advantage. All four cylinders of a pump can be ground in from 4 1/2 to 5 hours, as compared with the 10 hours formerly required. When crankpins and driving axles are ground, care must be taken in the selecton of wheels, on account of the shape and size of the fillet on the axles and pins, because side pressure will, unless properly controlled, cause the grinding wheel to break.

Charts, however, are now furnished by the manufacturers of abrasive wheels for the purpose of assisting the shop man in selecting the wheel that will be best adapted to the use for which it is intended. These charts help to remove guesswork in the shop when ordering wheels; the experimental work has been done by the wheel manufacturer to avoid extensive errors in the selection of wheels.

Milling, drilling, and turning operations were also briefly considered by Mr. North. In turning from bar stock, considerable savings have been made recently in railroad shops by means of chucking devices which, in combination with improved features of machine tools, have saved a great deal of time. As an example, it was mentioned that a few years ago 30 minutes was considered good time

for boring a locomotive tire 49 1/2 inches inside diameter. This operation is now done on a special heavy-duty boring mill in 7 minutes. Thirty odd years ago it required from 45 to 50 hours to turn a pair of 56-inch tires. The present time is about 50 to 60 minutes per pair.

Machine Tools in the Implement and Tractor Industries

An interesting comparison between the use of machinery in the agricultural implement industries in the past and in the present was made by Mr. Sklovsky in his paper "Machine Tools in the Implement and Tractor Industries." Prior to 1880, the number of machine tools used for production purposes in the agricultural implement industries was less than one machine to every twenty employes. These machines were nearly all drilling machines and represented an investment per employe of about $10. Other production machines numbered about one for every five employes and represented an investment of $100 per employe.

During the period between 1880 and 1900, the machine tools introduced increased to one machine for every ten employes, representing an investment per employe of $50. Other production machinery increased to one machine for every three employes, representing an investment per employe of $500.

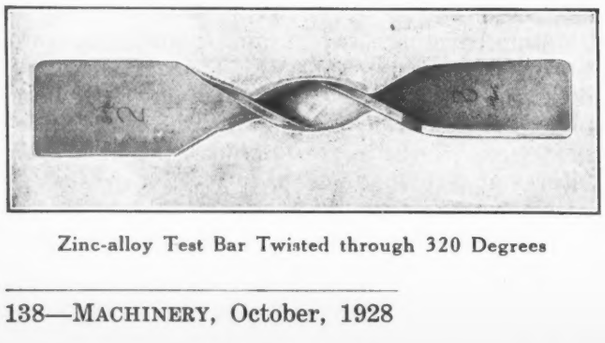
From 1900 to 1915 the investment in machine tools per employe increased to about $100 and of other production machinery to about $1000. Since 1915 the number of machine tools has increased to one machine for every six employes, the investment being about $200 per man. Other production machinery has increased to one machine for each 1.5 employe, the investment being about $2500 per employe. In the tractor industry, the machine tool investment per employe is about $1500, and additional production machinery to the extent of about $1000 per employe is used.

* * *

IMPROVED DIE-CASTING ALLOY

In May, 1927, MACHINERY an illustration was shown of a standard test bar made from a zinc base die-casting alloy which was twisted through 240 degrees without showing any signs of cracks. The Superior Die Casting Co., 875 East 70th St., Cleveland, Ohio, from whom this test bar was obtained, informs us that recent improvements made in this die-casting alloy have resulted in a metal from which test bars can be made that can be twisted through 320 degrees without any signs of cracks.

This zinc-base alloy is known as "SuperCast Alloy No. 2." It has a tensile strength in excess of 45,000 pounds per square inch, and an elongation of from 3.5 to 6.5 per cent. The test bar illustrated is of the standard 1/2- by 1/8-inch cross-section.

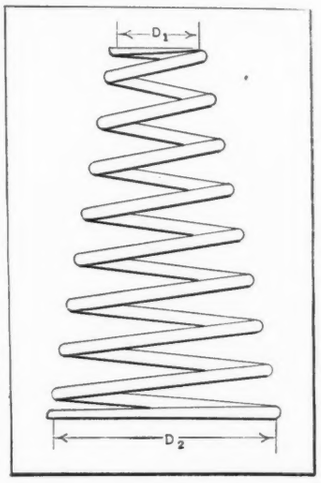


Zinc-alloy Test Bar Twisted through 320 Degrees

CONICAL SPRING CHARTS

By J. W. ROCKEFELLER, Jr.

The charts for use in making coil spring calculations given on pages 874 and 875 of July, 1924, MACHINERY may be used in calculating the deflection of conical extension springs having no initial tension, and for calculating the deflection of conical compression springs in which the pitch is such that all coils close simultaneously. When using these charts for conical springs such as shown in the accompanying illustration, the equivalent mean diameter D to be used in obtaining the deflection or stretch from the charts may be determined by employing the formula:



Conical Spring

$$D = \sqrt[3]{\frac{(D_2^2 + D_1^2)\ (D_2 + D_1)}{4}}$$

In this formula, the largest and smallest mean diameters of the coil are represented by D_2 and D_1, respectively. Let us assume, for example, that we have a conical spring of the following specifications, and that we desire to find the total deflection of the spring: The solid height equals 3 inches, the largest mean diameter equals 3 inches, the smallest mean diameter equals 1 inch, the size or diameter of the wire equals 0.105 inch, and the load equals 2 pounds.

The first step is to find the equivalent mean diameter D according to the formula given in the foregoing. Substituting numerical values:

$$D = \sqrt[3]{\frac{10 \times 4}{4}} = 2.15 \text{ inches}$$

Turning to the table on page 874 of July, 1924, MACHINERY, we find that the stretch or deflection per inch of solid height per 100 pounds load is approximately 52 inches. Now since the spring is to carry a load of 2 pounds and has a solid height of 3 inches, the total deflection will be

$$\frac{52}{100} \times 2 \times 3 = 3.12 \text{ inches}$$

* * *

CLEANING VALVE STEM GUIDES

One of the most troublesome jobs in automobile repair shops is the cleaning or removing of carbon from valve stem guides. Wire brushes and reamers are usually employed for this work. An interesting new tool has been placed on the market by the Scully Steel & Iron Co., 2364 S. Ashland Ave., Chicago, Ill., for valve stem guide cleaning. This cleaner is of the same construction as the Ruggles flue cleaner which has been used many years for removing carbon from boiler tubes in steam plants.

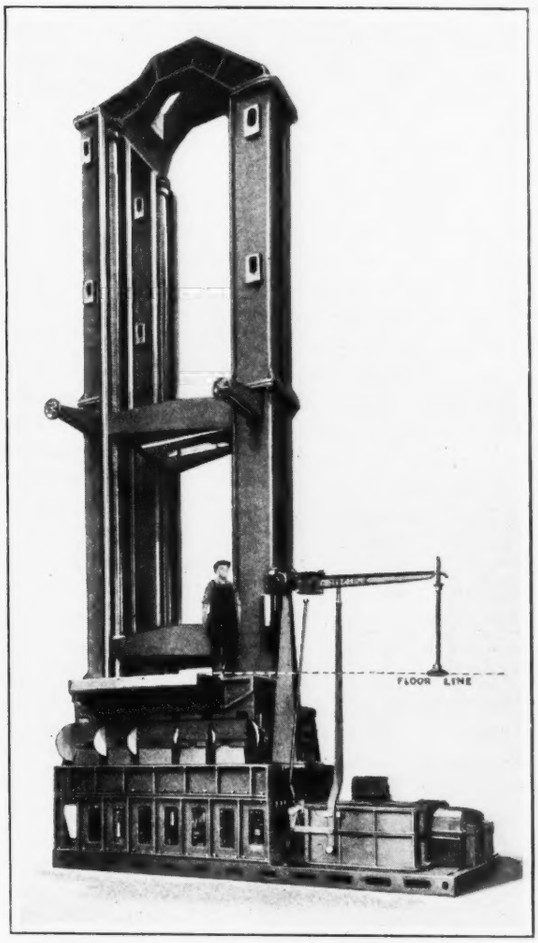
New Machinery and Tools

The Complete Monthly Record of New Metal-working Machinery

RIEHLE MACHINE FOR TESTING CABLES OF NEW HUDSON RIVER BRIDGE

It is only natural to expect that the designing of a suspension bridge having the magnitude of the Hudson River Bridge to be constructed between New York City and Fort Lee, N. J., would produce a host of problems. With 3500 feet intervening between towers, the structure will have a main span suspended over water that will be twice the length of the main span of the Delaware River Bridge, which now has the longest single span of any suspension bridge in the world.

One of the major problems, that of making the cables, has been given to the John A. Roebling Sons Co., Trenton, N. J., the firm that built the cables for the famous Brooklyn Bridge and that during the last seventy years has made most of the wire rope and cables used in suspension bridges erected all over the continent. The chief problem of this company on the Hudson River Bridge job was not that of producing or twisting wire, but of determining what combination of wire was capable of bearing the enormous stresses and strains to be contended with. No testing machine of sufficient size to test such gigantic cables was in existence. However, the concern subsequently made plans to purchase a machine capable of exerting the tremendous pull of 2,000,000 pounds. The order for this machine, which is shown in the accompanying illustration, was placed with the Riehlé Bros. Testing Machine Co., 1424 N. Ninth St., Philadelphia, Pa.



Riehle Universal Testing Machine Having a Load Capacity of 2,000,000 Pounds

An essential part of the straining mechanism is the upper or stationary head, which is held in position by pins or keys passing through slots in the columns. Three sets of these slots give the operator the choice of different upper-head positions. The operation of changing the head position is facilitated by a device which withdraws or inserts the keys as a handwheel is turned. This head is raised or lowered to the desired position by means of the moving head, while the keys and their respective operating apparatus are handled by a crane which serves the machine. The pulling head is moved up and down, as desired, by three screws.

The two heads are 24 inches thick and weigh nearly 25,000 pounds each. Rectangular cored slots permit specimens to pass through the heads. The lower surface of the pulling head and the upper surface of the fixed head have machined T-slots to permit the attachment of tools or fixtures to suit various specimens.

One of the pulling screws is 11 1/2 inches in diameter, 38 feet 4 5/8 inches long, and weighs 13,620 pounds. This screw sustains a load of 1,000,000 pounds at full capacity. The other two screws are 8 1/2 inches in diameter, of the same length as the front screw, and weigh 7470 pounds each. They sustain a load of 500,000 pounds each at full capacity. The Riehlé patented reversed screw principle is employed, so that the rotative effect on the head resulting from the friction of the screws turning in the nuts is practically neutralized. The screws are rotated by a train of gears, the shafts of which are mounted in radial roller bearings at the top and bottom. Thrust bearings underneath carry their weight. The pull of the screws is taken on large roller thrust bearings, spherically seated washers providing self-alignment.

Speed change-gears and a friction clutch assembly are contained in a box bolted to the base of the machine as a separate unit. Four different pulling speeds are obtainable by operating a single lever. A second lever serves to operate the clutch for starting the machine in either direction and for stopping. Power is derived from a 75-horsepower adjustable-speed motor of from 800 to 1600 revolutions per minute, and is transmitted through a Link-Belt silent chain.

While the loading or straining system is necessarily of rugged construction throughout, the most massive parts are found in the weighing system. For instance, the table is a one-piece steel casting 13 feet long by 11 feet 1 inch wide on its upper

surface, and weighs 48,850 pounds. At full capacity it sustains a load of 2,000,000 pounds which, in turn, is transmitted to the lever system on hardened steel knife-edges. These knife-edges are designed for a unit load of 10,000 pounds per linear inch, so that the total length of the knife-edges is in excess of 200 inches. Two primary main levers mounted on opposite sides of the machine with their noses turned upward each carry a load of 1,000,000 pounds. A fraction of this load is transmitted to a pair of secondary intermediate levers by means of which the load, now reduced to 1000 pounds, is transmitted to the weighing beam.

The recoil apparatus, which takes heavy shocks occurring when specimens break under large loads, is of the hydraulic type. It is automatic and does not affect the sensitiveness of the beam. The load is weighed on a beam of the conventional type on which the poise is moved by a screw operated through a train of gears actuated by a handwheel. The screw carries a micrometer dial for reading small increments of load.

This entire universal testing machine weighs about 275,000 pounds, and is 42 feet 10 3/4 inches high. Its extreme width is 13 feet, and the length, 21 feet. The maximum length of specimen that can be tested is 25 feet, while the clear space of 75 inches between the screws provides ample room for large pieces. The power capacity of the machine is sufficient to pull apart a bar of structural steel nearly 6 inches square or to crush a cast-iron column 15 inches in diameter, 15 feet long, and having 1 1/4-inch walls.

NATIONAL HIGH-DUTY FORGING MACHINES

Several new types of high-duty forging machines in actual operation were recently exhibited by the National Machinery Co., Tiffin, Ohio, at the plant of that concern. These machines have been designed with a view to obtaining machine-made forgings having an accuracy of size and shape closely approaching the results obtained in die-castings. Automobile transmission and differential gears produced in these machines can be completely finished by taking cuts of from 1/32 to 1/16 inch deep only. Ball- and roller-bearing races have been held within a variation of 0.010 inch on a 3-inch diameter. The ends of "sucker rods" used in oil-well pumping can be upset and held within a variation of 0.002 inch on a 1-inch diameter.

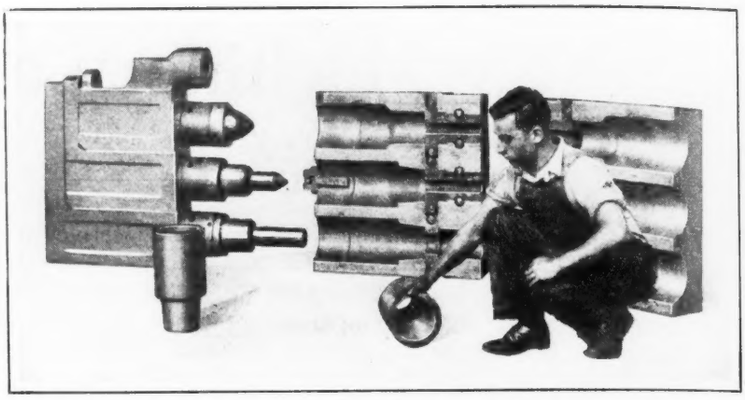


Fig. 2. Hollow-steel Part Produced by Internal Displacement Forging and the Dies Used

By means of a comparatively recent development known as "internal displacement" forging, holes can be so accurately formed in these forging machines that only from 0.015 to 0.020 inch of metal need be removed for finishing. As a result, holes can be finished either by broaching or reaming, drilling being completely eliminated. An internal displacement forging and the dies in which it is made are illustrated in Fig. 2. The part is a hollow tool joint used in oil-well drilling. It is 14 inches long, and the outside and inside diameters at the large end are 8 1/4 and 6 1/8 inches, respectively.

To permit the production of low-weight accurate forgings, the machines are designed with bed frames of increased rigidity and have tie-bars unusually large in diameter, located at the top of the beds to resist tension, as may be seen in Fig. 1. The machine shown in this illustration is believed to be the largest forging machine ever built. It weighs approximately 365,000 pounds or 183 tons.

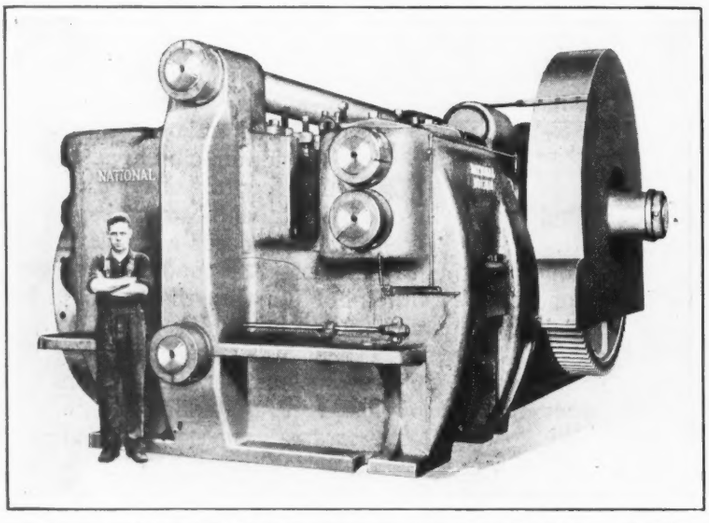


Fig. 1. National High-duty Forging Machine Weighing 365,000 Pounds—the Largest Forging Machine Ever Constructed

Of equal importance is the design of the heading and gripping slides. These slides, for the machine illustrated in Fig. 1, are shown in Fig. 3. Unusual length is provided for the heading slide by the overarm construction which extends over and beyond the crankshaft. The added length, combined with the narrow width, gives the accuracy of movement that is required in the production of internal displacement forgings.

The same principle of design has been applied to the gripping slide which carries the moving die, the long outboard support being an important factor in securing close registration of the die impressions. This construction, combined with a powerful gripping action, keeps the dies closed against the hydraulic action of heading dies on hot stock, the cocking or wabbling of old-style gripping slides, which allowed

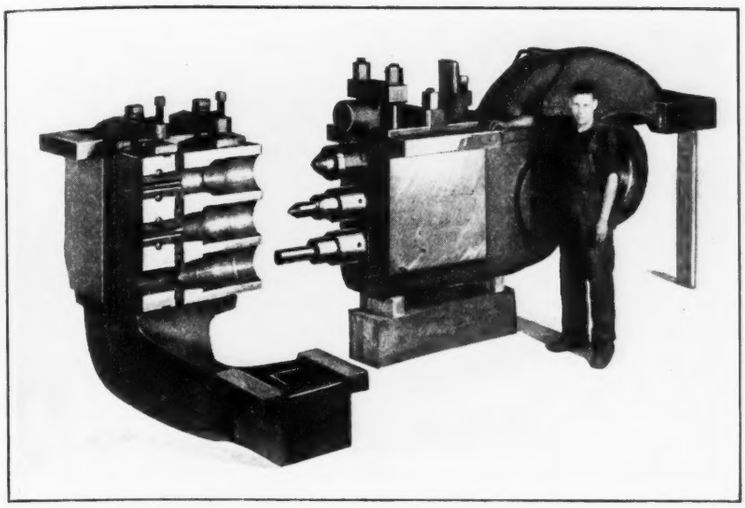


Fig. 3. Heading and Gripping Dies of the Machine Illustrated in Fig. 1

dies to open up and cause swollen shanks and part-line flash, being thus eliminated.

To prove the worth of the new bed design, of the long heading and gripping slides with their outboard bearings, and the increased gripping power of the dies, a comparative test was made. In this test, large-diameter, high-carbon steel rings were forged directly off the bar. The maximum permissible variation in the width of the rings was 0.040 inch. In an old type machine, only two or three rings could be made in one heat, after which the drop of 150 degrees in the temperature of the bar resulted in so much resistance of the material that the bed would spring to an extent which prevented the forging of additional rings within the variation limit. In the new machine, eight rings were made without exceeding the tolerance.

Features that facilitate operation of the machines have also been incorporated in their design. The former foot-treadle starting clutch, which required the operator, while holding the bar, to balance his weight on one foot and start the machine with the other, has been replaced by an air-operated trip. The operator controls this air trip by the toe of one shoe without disturbing his balance and with no more effort than is required to press the accelerator of an automobile. To obtain fast starting, a four-abutment starting clutch is used, which causes the machine to start within a quarter of a revolution or less of the main driving gear. This quicker starting means less temperature drop per forging or more forgings per heat from the bar.

CINCINNATI BRAKE-DRUM GRINDING MACHINE

A brake-drum grinder designed for finishing the drums used on the lighter classes of automobiles is the latest addition to the line of grinding equipment built by Cincinnati Grinders, Inc., Cincinnati, Ohio. This machine is designed to grind internal diameters up to 12 inches. The main bed casting is of the box type, with the wheel-head as an integral part. This casting weighs about 2700 pounds. The grinding-wheel spindle is a chrome-nickel steel forging, and is driven by a chain from a sprocket in the bed directly beneath it. Lubrication of the grinding wheel spindle is accomplished automatically by means of a pressure feed system, which insures continuous circulation of filtered oil over the bearings.

All major operations of the machine are accomplished by air, the aim of the designers having been to eliminate as far as possible hard physical labor in running the machine. The entire work-head is pivoted on an in-feed slide and is moved to and from the grinding position by means of air. It is controlled through a conveniently located hand-valve. Similarly, the drums are clamped on the faceplate by means of a quick-operating air chuck.

To facilitate smooth operation, the work-head is counterbalanced and all sliding surfaces are lubricated by the Alemite system. A two-horsepower constant-speed direct-current motor is mounted on the swivel head, and is direct-connected through a flexible coupling to worm-gearing which rotates the air chuck spindle. The drums are located from the hub bore or, as in the case of Ford drums, from the surfaces provided for Timken tapered roller bearings. The work-head motor is automatically started and stopped by means of a switch contained in the swivel head. The motor is automatically started when the head is moved into the grinding position and automatically stopped when the head is swiveled into the loading position. This method of control relieves the operator of many otherwise necessary movements, and thereby decreases the unproductive time and increases the output.

After the work has been brought into contact with the grinding wheel, a downward movement is imparted to an in-feed lever to feed the drum into the grinding wheel; this results in removing

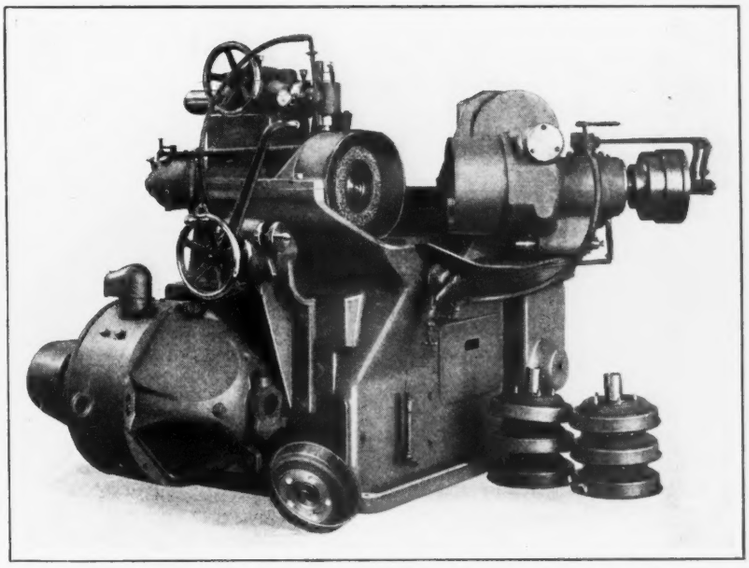


Fig. 1. Cincinnati Brake-drum Grinder Intended for Automobile Brake-drums Having an Internal Diameter Up to 12 Inches

from 0.015 to 0.020 inch of stock, thus obtaining the desired finish in one operation. A hand in-feed screw and a micrometer adjustment are built into the in-feed unit to permit accurate wheel settings to compensate for wear. The in-feed movement is easily operated up to a dead stop.

Truing of the grinding wheel is accomplished by means of a hand-dresser, which is permanently mounted on the wheel-head directly over the wheel. A separate coolant system controlled by a small valve supplies dressing coolant, the coolant delivered during grinding being automatically started and stopped with the movement of the swivel head. The coolant pump is of the impeller type, and is driven from the main drive shaft. In addition to a settling tank in the bed of the machine, a 40-gallon reservoir is supplied to insure an ample flow of clean coolant over the wheel and work. Power is supplied to the grinding wheel spindle, and coolant and oil pumps by a 20-horsepower main-drive motor, fastened to a pad on the machine bed. The drive to the main shaft is through a silent chain, adequately covered.

After the operator has loaded a drum on the work-head, one air valve is operated which causes the chuck to clamp the drum rigidly. Then when a second valve is operated, the drum moves into

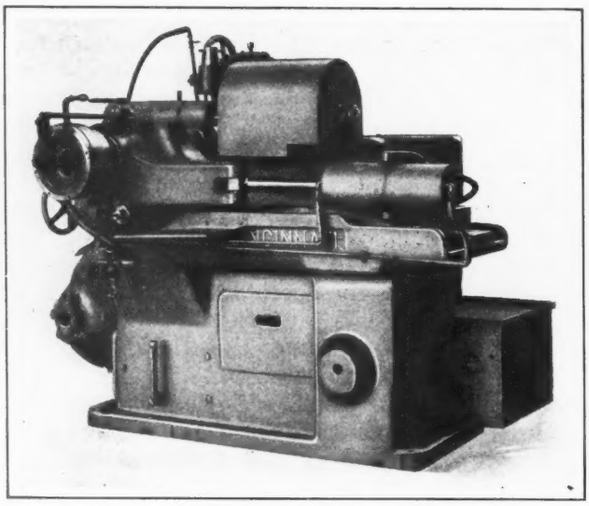
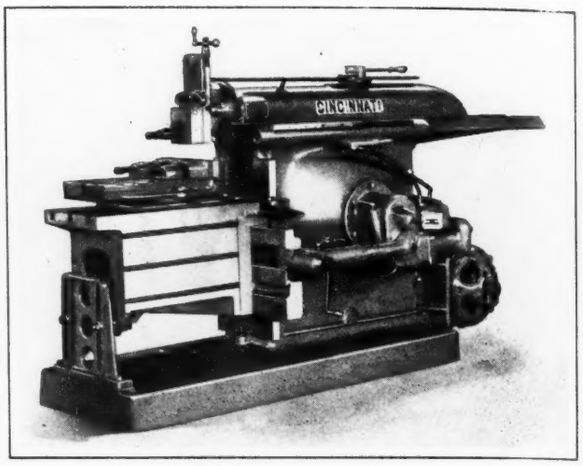


Fig. 2. View of the Brake-drum Grinder Showing the Pneumatic Equipment Employed for Operating the Work Chuck and Swiveling the Work-head

the grinding position, its rotation starts, and coolant flows over the wheel and work. With the downward movement of the in-feed lever, the grinding is accomplished, after which the drum is brought back into the loading position. Machines now in operation have a production of approximately sixty drums per hour, floor-to-floor time, with one operator to a machine.

CINCINNATI RAPID-TRAVERSE SHAPER

A new 36-inch rapid-traverse shaper designed to combine the speed of a small machine with the rigidity of a large one has been brought out by the Cincinnati Shaper Co., Elam St. and Garrard Ave., Cincinnati, Ohio. This shaper has a ram 6 feet 4 inches long with a bearing in the column of 3 feet 10 inches. The shaper occupies a floor space of



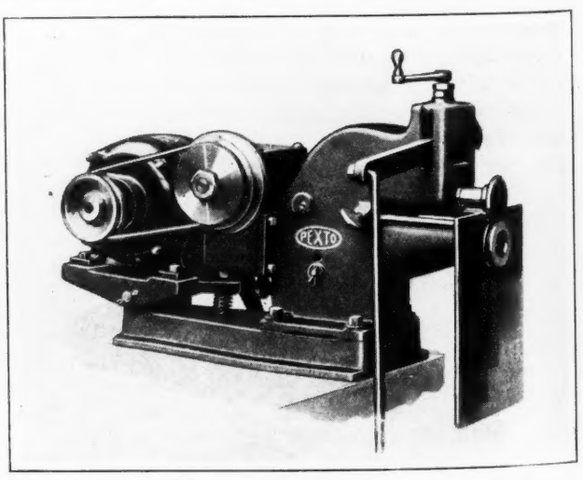
Cincinnati 36-inch Rapid-traverse Shaper

12 feet 1 inch by 5 feet 2 inches. It is provided with a range of strokes from 8 to 102 per minute, and with eleven cross-feeds from 0.010 to 0.170 inch.

In general design, this machine closely follows the shapers described in August, 1927, MACHINERY, page 951. It is provided with a power rapid traverse to the table and an automatic oiling system. Speed and cross-feed changes are quickly made. Every control lever is within a circle having a 14-inch radius. Other features include an improved "spring-throwout" hand feed, and quick-control indicators which tell at a glance the feed, speed, and length of stroke being used. The shaper is either furnished with a single-pulley belt drive or arranged for a motor drive. A universal table consisting of a revolving table with a rocking top is now in production for use on this machine.

"PEXTO" ROTARY SHEET-METAL WORKING MACHINE

Crimping, beading, turning, wiring, burring, elbow-edging, and furnace-collar edging can be performed on sheet metal with a motor-driven universal rotary machine recently developed by the Peck, Stow & Wilcox Co., Southington, Conn. Cutters can also be applied to this machine for slitting or trimming, ventilating and smoke pipe. The machine is driven by a 1/8-horsepower motor from



Rotary Metal-working Machine Built by the Peck, Stow & Wilcox Co.

a regular 10-ampere fuse line. Twisted and open belts provide forward and reverse drives. Through step cone pulleys, the roll shafts can be run at 50, 75, or 100 revolutions per minute.

The machine has capacity for working No. 22 gage soft steel when turning, burring, wiring, beading, elbow-edging or collar-edging rolls are employed. In crimping, the capacity is slightly decreased to No. 24 gage stock. No. 20 gage stock can be trimmed and slit. The various rolls are interchangeable. Complete with the motor, the machine weighs 105 pounds. It can be used as bench equipment or furnished with an iron floor pedestal.

NEWARK "SPIRIT OF PRODUCTION" HOBBING MACHINE

A hobbing machine designed for either quantity production or jobbing shop service has recently been developed by the Newark Gear Cutting Machine Co., 69 Prospect St., Newark, N. J. For quantity manufacture of one or a few parts, this machine may be furnished without such features as the rapid traverse, automatic down feed, or differential mechanism, and special attachments may be provided, whereas for jobbing shop service, all these features are available. The trade name "Spirit of Production" has been given to the new machine, and it is known as the No. 3. The machine has a capacity for hobbing gears up to 18 inches in diameter under the over-arm which ties together the vertical stanchions. Without this over-arm, gears up to 24 inches in diameter can be handled.

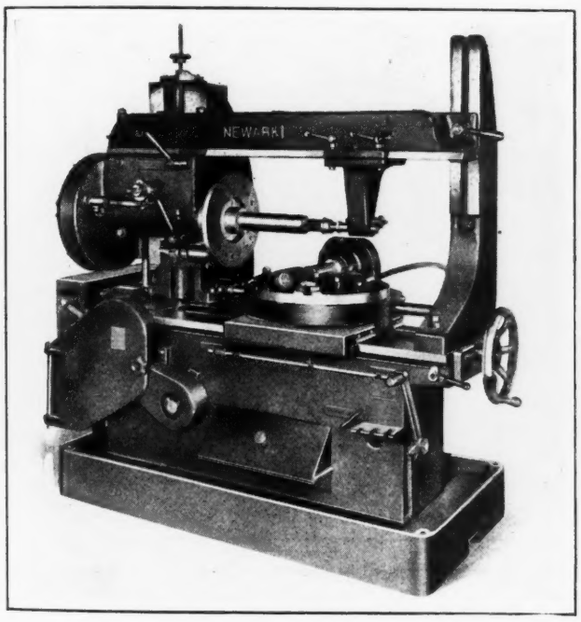


Fig. 1. Newark Gear-hobbing Machine Designed for Quantity Production or Jobbing Shop Service

This machine is built in both universal and plain types. The universal type is intended primarily for hobbing helical, herringbone, and spur gears and worm-wheels. The distinguishing feature of this type is an improved differential mechanism used in hobbing helical and herringbone gears. This mechanism provides a separate and easy control of the lead, feed, and indexing trains of gearing, so that for a given helical angle and pitch, the number of teeth only is considered when changing over the machine. Any desired feed may be obtained at any time without losing the helical path and without recalculating the gear train ratios. The plain type is furnished primarily for cutting spur gears, spline shafts, and worm-wheels. It does not require the differential mechanism, although this can be furnished as extra equipment.

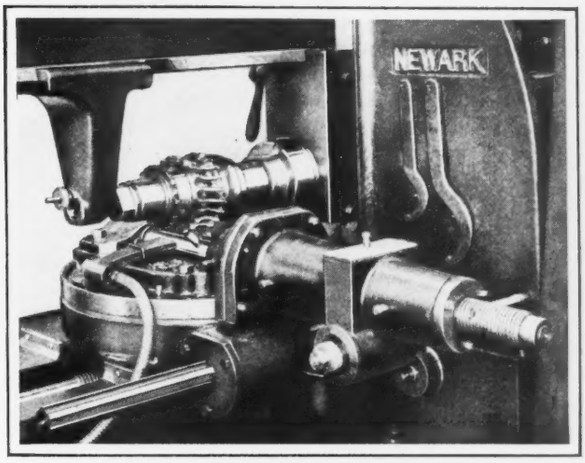


Fig. 2. Tangential Attachment for Generating Worm-wheels with Taper Hobs, Star Cutters, and Fly Tools

With the horizontal cutting principle employed, long shafts or gears solid with shafts can be conveniently handled. The work-spindle is bored to 2 1/2 inches for this purpose. The box over-arm and its outer support furnish a rigid mounting for the sliding arm that supports the work-spindle. The outer support is so arched that the sliding arm may be removed directly from the over-arm for long special work.

A feature of the cutter drive is the location of the cutter-spindle close to the frame ways, this construction giving increased rigidity. Power for driving the cutter is delivered by a splined side shaft through a hardened and ground worm to a combined worm-wheel and bevel-gear ring and then to a bevel gear mounted directly on the hob-spindle. Three rotating gear members thus perform the function of two distinct pairs of gears. The ring gear also acts as a flywheel to steady the

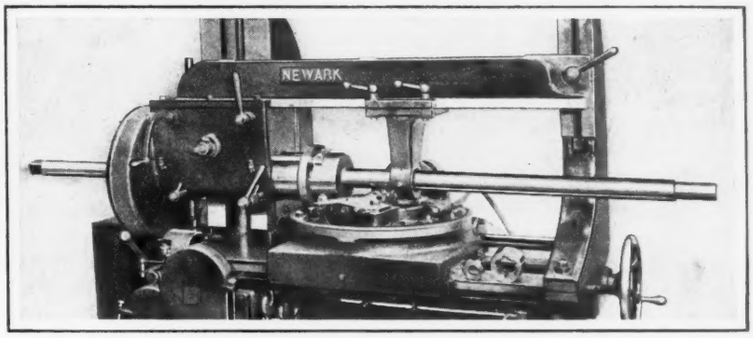


Fig. 3. Attachment Used for Automatically Hobbing Long Multiple-spline Shafts

cutting action. It is completely guarded and out of the way. A hole 4 7/8 inches in diameter in the center of the ring gear conveys the cutting coolant and chips to a box in the frame beneath. The worm is mounted on Timken tapered roller bearings. There is a rapid traverse movement to the cutter carriage in both directions, whether the hob is revolving or not.

The control levers of the machine are concentrated on the working side. An automatic lubricating pump is supplied for the gear-box parts. The speed change gears are driven by square shafts, while the lead, feed, and indexing gears are driven by double-key shafts on which the keys are machined solid with the shafts. The master worm-wheel is generated in place on its bearings, and the master worm is mounted on Timken bearings.

The machine can be provided with equipment for special-purpose work. Fig. 2 shows a tangential attachment for generating worm-wheels with taper hobs or star cutters and fly tools when no hobs are available. This attachment is readily applied to the machine by first removing the outer cap bearing of the cutter-spindle. The rapid traverse and differential mechanism function with this attachment.

Fig. 3 shows an attachment furnished for automatically hobbing long multiple-spline shafts. The regular cutter carriage is clamped to the frame ways when this attachment is in use, and the regular feed mechanism is disengaged. Shafts being hobbed are automatically fed through the work-spindle. Any number of splines may be hobbed, and the shafts may be of any practicable length.

This hobbing machine has a capacity for cutting teeth of 4 diametral pitch in steel at a fast rate, and occasionally, teeth of 3 diametral pitch. Teeth of 3 diametral pitch can be cut in gray iron. The maximum size of hob that can be used is 4 1/2 inches in diameter by 5 inches long. For full capacity, a five-horsepower motor of the constant-speed type, running at about 1200 revolutions per minute, should be used. Hob speeds of from 38 to 145 revolutions per minute are available, and hob feeds of from 0.015 to 0.250 inch per revolution of the work. The machine weighs about 6000 pounds.

DEFIANCE HORIZONTAL MULTIPLE-SPINDLE DRILLING MACHINES

Two special fixed-center multiple-spindle drilling machines of the horizontal type have recently been built by the Defiance Machine Works, Defiance, Ohio, for drilling holes in transmission cases, cylinder blocks, etc. The machine illustrated in Fig. 1 is designed for drilling all holes in one end and in the bottom of transmission cases, while the machine shown in Fig. 2 produces all the holes in two opposite sides of transmission cases. The first-mentioned machine has a net weight of 18,700 pounds and occupies a floor space of 11 feet 6 inches by 11 feet, while the other machine weighs 19,580 pounds and requires a floor space of 15 feet by 5 feet 4 inches.

The multiple-spindle heads of both machines are fitted with alloy-steel spindles, which run in Timken tapered roller bearings. The spindles are driven by stub-tooth heat-treated gears which are enclosed and continuously oiled by force-feed lubrication systems. On the machine shown in Fig. 1, the right-hand head has twelve spindles, which are driven by a 7 1/2-horsepower motor, while the left-hand head has thirty-nine spindles, driven by a 10-horsepower motor. The right-hand head of the machine illustrated in Fig. 2 has thirty-six spindles, and the left-hand head has thirty-one spindles. Both of these heads are driven by 15-horsepower motors. The motors for driving these multiple-spindle heads on both machines are direct-connected to the heads by means of flexible couplings, and run at a speed of 1150 revolutions per minute.

Each machine is equipped with a substantial fixture, provided with a hardened plate and locating pins for centering the work. Both machines also have a roller conveyor table that is raised and lowered by means of eccentrics to first serve as a stripper for raising the work off the locating pins and then as a roller conveyor. Heavy jig plates mounted on the fixture are fitted with removable jig "eyes" for guiding the various sizes of drills. The box-type bases are of heavy rigid design and have broad ways on which the multiple-spindle heads

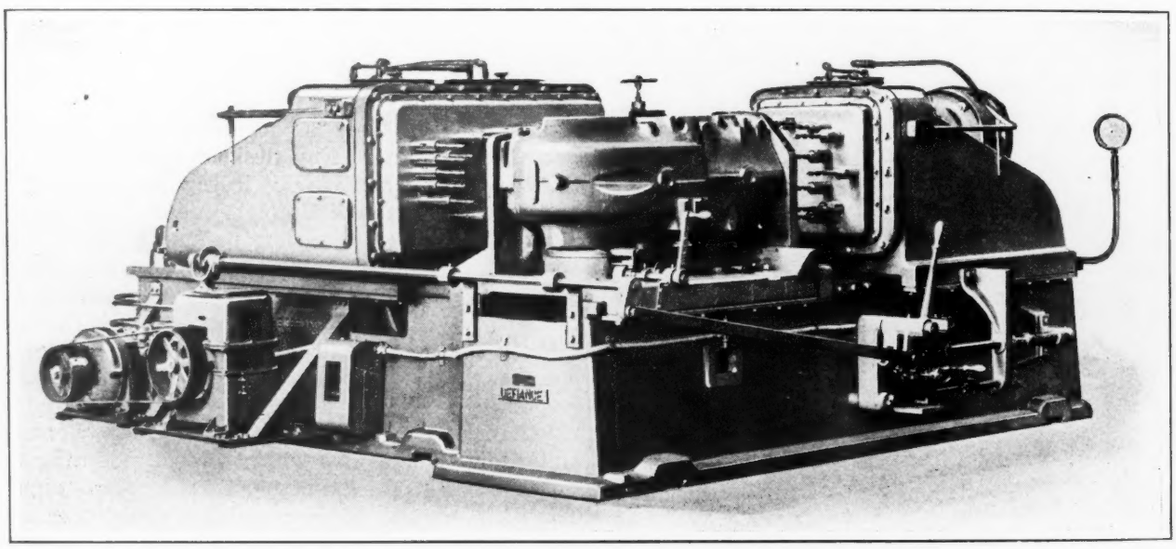


*Fig. 1. Defiance Multiple-spindle Drilling Machine with Two Heads at Right Angles on a Horizontal Base

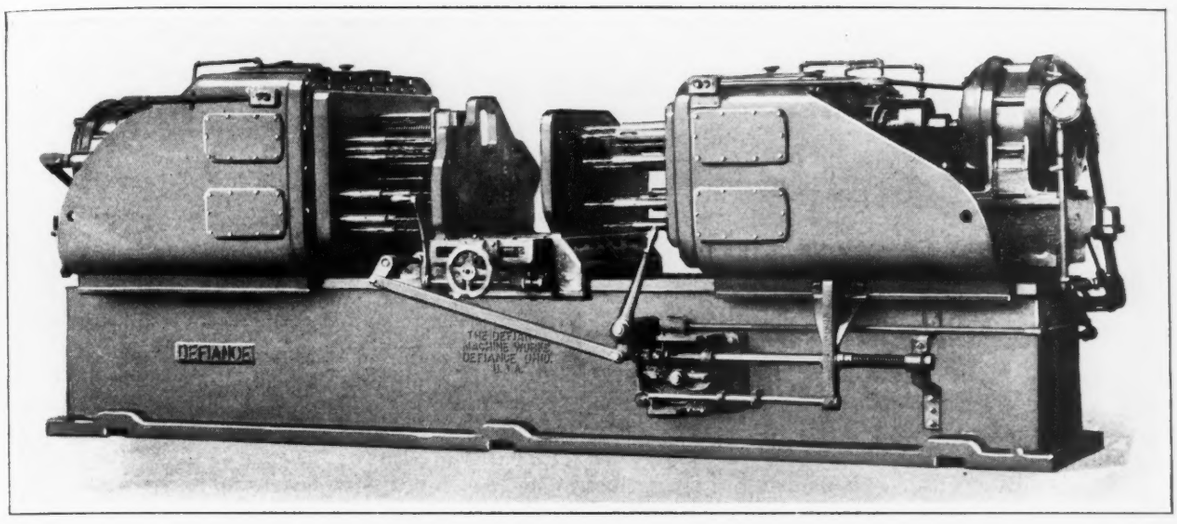


Fig. 2. Multiple-spindle Drilling Machine of Horizontal Type with Two Opposed Heads

slide. The bases of the machines are well ribbed throughout.

An Oilgear feed is furnished on both machines. Cylinders for these feeds are mounted in the bases under the heads. The cycle of each head consists of a rapid traverse forward, then a feed at the desired rate for drilling, next an automatic kick-off, and finally an automatic return. On the machine shown in Fig. 1, the heads have a stroke of 16 inches, and on the machine illustrated in Fig. 2, the stroke of each head is 18 inches. The two heads of each machine are equalized through a rack and pinion. The Oilgear pumps are driven by three-horsepower motors running at 860 revolutions per minute.

The production obtained on each of these machines is one drilled transmission case every two minutes, which includes the time consumed in drilling the case and in loading and unloading the machine. Both machines can also be fitted with mechanical screw feeds instead of the Oilgear feeds, and rapid traverse movements can be provided with the screw feeds.

WAGNER MOTOR BEARING CONSTRUCTIONS

Sleeve-bearing and ball-bearing constructions recently adopted for motors manufactured by the Wagner Electric Corporation, 6400 Plymouth Ave., St. Louis, Mo., are here illustrated. The sleeve bearing shown in Fig. 1 is of the two-ring type. One of the important features of these sleeve bearings is that the oil well is sealed against the entrance of dirt and the leakage of oil. A cork gasket seals the cover and prevents leakage of oil thrown up by the oil-ring, while a wide ring seals the housing at the pulley end, and a dust-cap which is press-fitted into place seals the front end. A thrust collar with an oil slinger makes it impossible for oil to pass into the motor. Sealing grooves afford extra precaution against the leakage of oil or entrance of dust.

A filler and overflow plug located at the proper oil level not only makes oiling easy, but also prevents over-oiling. The oil-rings are of one-piece construction and are held in place by guards. A set-screw prevents the bearing from rotating or shifting. All Wagner horizontal motors, with the

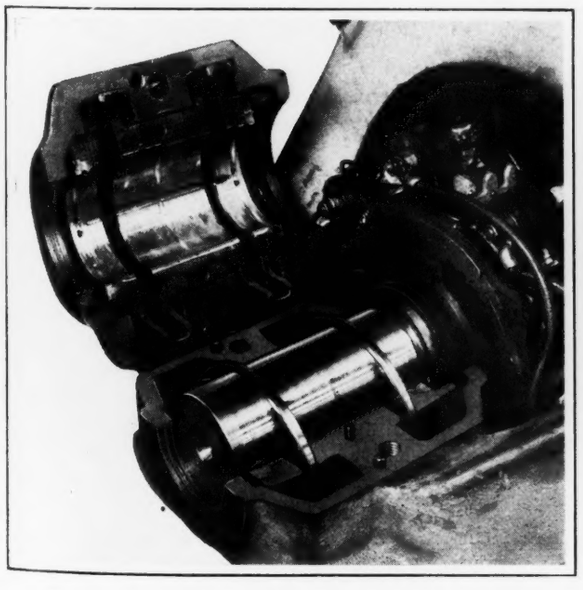


Fig. 1. Improved Two-ring Sleeve Bearing Used in Wagner Motors

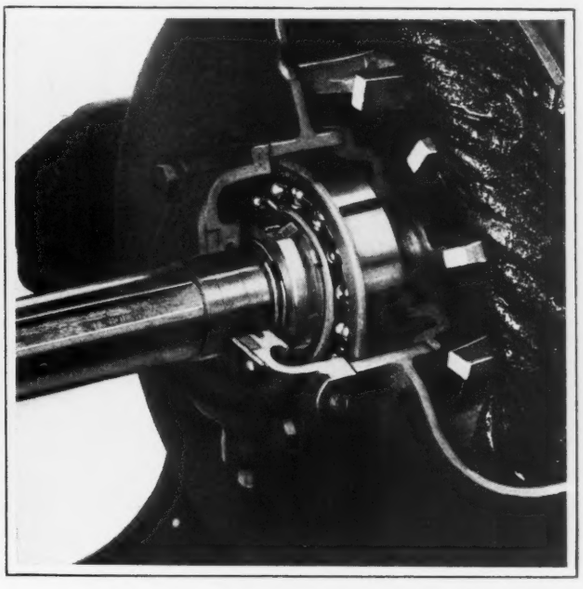


Fig. 2. Double-cap Ball-bearing Construction Employed in Wagner Motors

exception of air-jacketed and high-speed motors, may be obtained with the sleeve-bearing construction.

The ball-bearing construction, as may be seen in Fig. 2, is of double-cap design, the ball bearing being housed between two caps that are bolted together. This construction facilitates bearing replacement and makes it possible to remove or assemble ball bearings in a dust-laden atmosphere without danger of foreign matter getting into them. The fit between the outer race of a bearing and the bearing housing is such as to permit the outer race to creep or rotate slowly and thus distribute stresses uniformly. To hold the inner race firmly in place on the shaft and yet permit easy removal, a slight shrink fit is used, together with a clamping nut and a lock washer.

A single-row deep-groove bearing takes the thrust load at the front end of the motor, and a double-row self-aligning bearing, or an equivalent deep-groove bearing, is used at the pulley end with the outer race free to adjust itself to variations in shaft lengths due to temperature changes. On vertical motors, single-row ball bearings are used at the top, and double-row self-aligning bearings or equivalent deep-groove bearings, at the bottom.

GENERAL ELECTRIC IMPROVED SINGLE-PHASE MOTOR

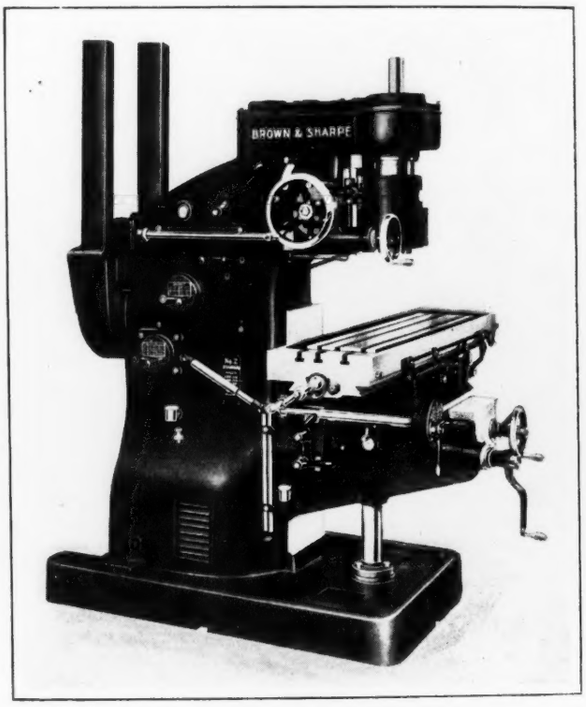
An improved single-phase repulsion induction motor is being placed on the market by the General Electric Co., Schenectady, N. Y., in 3/4-, 1-, 1 1/2-, and 2-horsepower sizes, which run at 1800 revolutions per minute. This new motor supplements the present line of S C R motors. It is of the constant-speed, high-starting torque type, and is intended for general application.

The motor is enclosed, except for ventilating openings in the lower portion of each end shield. Air drawn through openings at the pulley end by means of an internal fan, passes around the stator laminations and out through the openings in the commutator end. This construction makes a practically enclosed motor and provides protection against falling particles or splashing water. The motor is designed to operate within a temperature rise of 40 degrees C. By effecting a slight change in the enclosing features, the motor is made of the totally enclosed type, with a somewhat reduced rating.

BROWN & SHARPE "STANDARD" VERTICAL-SPINDLE MILLING MACHINE

The latest addition to the line of "Standard" milling machines built by the Brown & Sharpe Mfg. Co., Providence, R. I., consists of the No. 2 vertical-spindle machine illustrated. Horizontal-spindle machines of this line were described in the February and September numbers of MACHINERY. The vertical-spindle machine is available either with a belt drive, fitted for a motor, or equipped with a motor. On motor-driven machines, the motor is located in a ventilated compartment in the base and drives through a chain and sprockets. Adjustment of the driving chain tension is accomplished by means of a screw located on the outside of the compartment.

Anti-friction bearings are provided from the driving pulley to the spindle and in the feed and power fast travel mechanisms. Two operating positions are provided, one at the front and one at the rear of the table, all levers that control the operation of the machine being readily available from either position. There is a dual control for feed changes through a lever at the front of the table and one at the rear, while speed changes in two series are made by means of a single lever on one side of the machine. An automatic feed of the spindle is provided which can be controlled from either operating position. There is an automatic release which can be made to function at any point. The rates of feed or speed for which the machine is set are indicated by direct-reading dials located above the control levers. The power fast travel



Brown & Sharpe Vertical-spindle Milling Machine of "Standard" Series

is provided for longitudinal, transverse, and vertical movements, and is operated through a single lever.

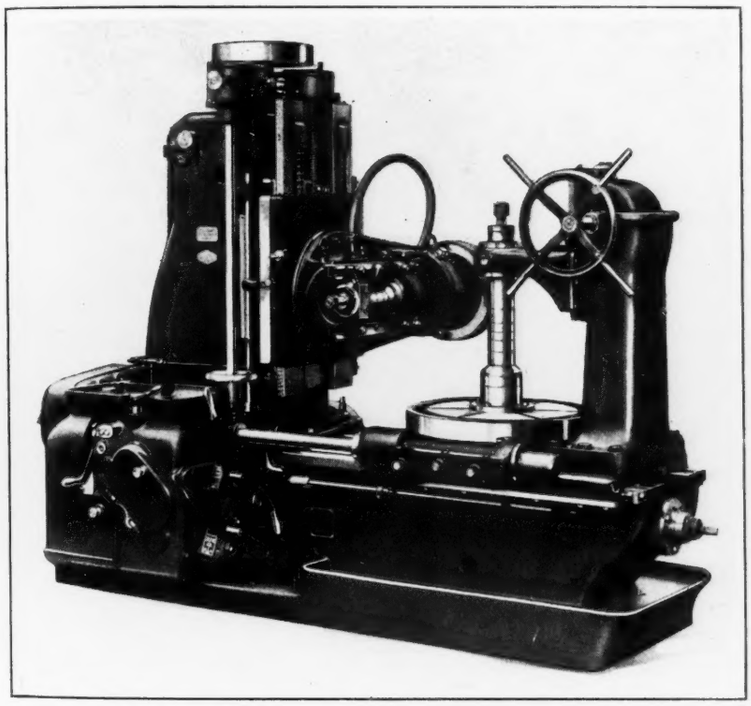
One of the important features of the machine is the automatic disengagement of the power fast travel and the simultaneous engagement of the cutting feed without any attention on the part of the operator. This feature saves time and prevents damage being caused by accidental jamming of the work into the cutters. After the fast travel has been engaged, the operator is free to tend another machine.

Automatic lubrication with filtered oil is provided for all mechanisms within the column, the driving pulley and the knee assembly. The knee elevating screw is in one piece, does not extend below the base of the machine and is guarded in all positions. The spindle head is counterbalanced and has a micrometer stop which facilitates controlling the depth of cuts.

SCHUCHARDT & SCHUTTE QUICK-CHANGE GEAR-HOBBING MACHINE

One of the exhibits of the George Scherr Co., 144 Liberty St., New York City, at the tenth National Metal Exposition to be held at Philadelphia, Pa., from October 8 to 12, inclusive, will be the new Schuchardt & Schütte quick-change gear-hobbing machine here illustrated. This machine is somewhat similar in design to the one described in January, 1927, MACHINERY, page 387, but it is of an entirely new size and embodies a number of important improvements that will be described in the following.

One of the principal improvements is a new differential and feed gear-box which contains all members for the transmission of movements. It encloses the differential gear which accelerates or retards the rotation of the table for cutting spiral gears and which is also required for the production of worm-wheels by means of the tangential feed head. Due to the independent arrangement of the differential gear, changes in feed or in the number of teeth of spiral gears to be cut do not affect any predetermined tooth angle. The differential mechanism simplifies the cutting of spiral gears and makes mathematical calculations unnecessary. By means of conveniently located levers the vertical and horizontal feeds are thrown in, and all movements of the work-table and table carriage, as well as of the cutter-head slide, are controlled in the same way. The levers for actuating the feeds and the quick power travel are interlocked.



Schuchardt & Schutte Quick-change Gear-hobbing Machine

Nine different changes of feed can be instantly made at any stage of an operation without stopping the machine. Additional feeds are obtainable through slip change-gears. The main drive is through a quick-change gear-box which furnishes six cutter speeds.

Stops for the vertical feed to the cutter-head and the horizontal feed to the table are tripped automatically. A power rapid traverse is provided both for the cutter-head and the table. There is a hand adjustment of the cutter-head by means of a hand-wheel on top of the feed gear-box, and of the table by means of a crank on the face of the bed. Quick return of the cutter-head is accomplished independently of the feed mechanism and, therefore, in cutting helical gears in two cuts, the rapid traverse is used without losing the spiral lead.

The machine is equipped with a swiveling type of arbor support on which the arm with the arbor bushing swings upward instead of sidewise. It can be swung entirely out of the way when not in use. The worm and dividing wheel, as well as the table, run in a continuous bath of oil, protected against dust and chips. The dividing wheel is directly under the table and of practically the same diameter. A three-bearing spindle construction is provided.

There are two flywheels on the machine, one on the end of the cutter-spindle and one on the vertical driving shaft. These flywheels steady the action of the cut to produce a smooth finish on gears. A tangential cutter-head can be furnished to permit the use of tapered hobs in cutting spur gears and helical gears having an angle up to 15 degrees. When an individual motor drive is desired, a "Texrope" drive can be supplied. The machine has a capacity for cutting spur gears up to 2 1/4 diametral pitch, 40 inches in diameter, and 14 inches face width.

SOCIETE GENEVOISE GEAR-TESTING MACHINE

A gear-testing machine designed for the quick inspection of gears for errors in pitch, concentricity, and tooth profiles has recently been developed by the Société Genevoise d'Instruments de Physique, Geneva, Switzerland. It is being introduced on the American market by the R. Y. Ferner Co., Investment Building, Washington, D. C. The machine is adapted to the testing of bevel and helical gears, as well as spur gears with straight or spiral teeth, except that the profile testing device is not adapted to checking bevel-gear teeth. Gears as large as 11 3/4 inches in diameter and varying from 2 to 25 in diametral pitch can be handled.

The gears to be tested are mounted on accurate mandrels between a fixed and an adjustable center, the latter being mounted in a carriage which moves on the bed through a range of 15 3/4 inches. Devices for checking the pitch and concentricity of gears are supported on a column secured to a base that is adjustable in a T-slot of the carriage. The indicators and their leverage system may be easily rotated to bring contact points in position for checking bevel gears of any angle.

The arrangement of the levers, contact points, and dial indicators for checking the pitch and con-

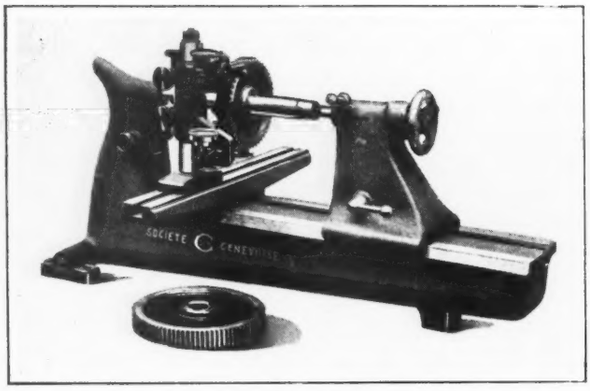


Fig. 1. Societe Genevoise Machine for Inspecting Spur, Helical and Bevel Gears

centricity of gears is shown in Fig. 3. Contact point *T*, which is mounted on lever *L*, is limited as to radial movement, and consequently registers on indicator *M* any amount of eccentricity. Contact point *X* on lever *Y* moves only tangentially and shows on indicator *Z* any variations in circular pitch. The contact points may be set to enter into two successive tooth spaces or they may be adjusted farther apart to span several teeth.

Rapid indexing and reading are facilitated by turning knob *P*, which carries a pin that shifts the eccentricity lever system when it is rotated, so as to disengage contact point *T* from the teeth. Simultaneously, an extension rod attached to lever *L* engages a pin set in lever *Y* to raise contact point *X* from engagement with the gear. Six pairs of contact points are regularly furnished with the machine to suit diametral pitches from 3.5 to 25, but additional sets can be supplied. These contact points consist of thin hardened steel plates. Two of them are mounted in parallel planes close together, but so arranged that they do not interfere when inspecting gears of fine pitches.

The dial indicators are readily set to zero on the first measurements, and consequently following readings indicate variations of the successive spaces from the first space. The accumulated error of pitch with the first space as zero can be readily found by taking the algebraic sum of the readings

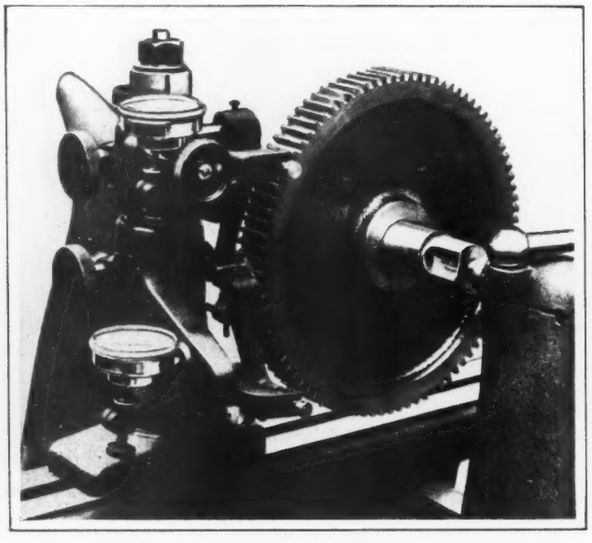


Fig. 2. Attachment Used in Checking the Pitch and Concentricity of Gears

to each point around the gear. The settings of the contact points on successive teeth and the corresponding readings can be made so rapidly that two persons can be employed to advantage, one to make the settings and readings and the other to record the results. A single observer can work even more rapidly if he has only to note whether the readings are within a fixed tolerance.

For testing tooth profiles, the carriage on which the indicators are supported is removed, and the bed of the machine, which is hinged at one end, is swung into the vertical position. A carriage that supports a profile device is then attached to the ways, and the mandrel carrying the gear to be inspected is placed vertically between the centers of the machine. The details of this profile-testing device were described in November, 1924, MACHINERY, page 239. With this device, variations on either flank of involute teeth may be determined and various pressure angles checked.

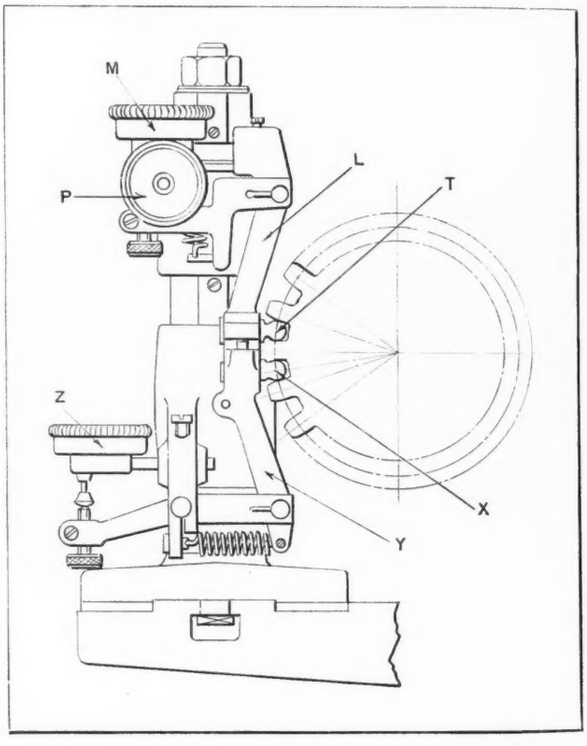


Fig. 3. Diagram of the Contact Points, Levers, Dial Indicators, etc.

This machine will be demonstrated at the National Metal Exposition which is to be held in Philadelphia, Pa., from October 8 to 12, inclusive.

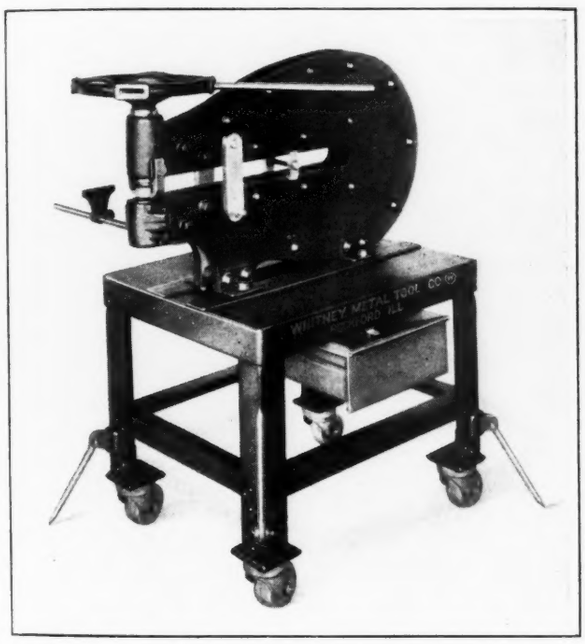
WHITNEY DEEP-THROAT PUNCHES

Two new punches, the main feature of which is the large throat clearance, have recently been brought out by the Whitney Metal Tool Co., Rockford, Ill. The No. 26 machine has a throat depth of 18 inches and capacity for punching a 2-inch hole through 3/32-inch sheet iron, while the No. 27 punch has a throat depth of 24 inches and capacity for punching a 2-inch hole through No. 16 gage material. Both machines are regularly equipped with side tie-rod plates as shown. When these plates are in postion, the machines have a 7-inch

throat clearance and capacity for punching 1/2-inch holes through 3/8-inch sheet iron.

The frame of these punches is made by hot-riveting together two steel plates 1 inch thick. The die-holder is of the bolster plate type, and bolster plates can be furnished with special dies as required. The truck-type base is supplied with a steel drawer which has a tray. The base has ball-bearing swivel casters, 4 inches in diameter, which easily roll over rough surfaces. Steel tripods bolted to the legs may be dropped to the floor to hold the equipment rigidly when in use. The tripods are simply lifted to move the equipment.

Handwheels are furnished for operating the two punches and a short lever, which is used in punching heavy materials. This lever can be inserted in four openings provided in the handwheel.



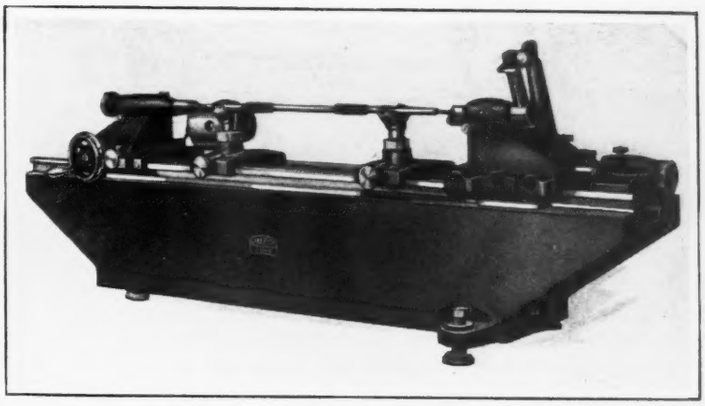
Whitney Deep-throat Punch Mounted on Portable Base

ZEISS OPTICAL MEASURING MACHINE

External and internal measurements, either absolute or comparative, can be made on a Carl Zeiss optical precision measuring machine now being placed on the market by the George Scherr Co., 144 Liberty St., New York City. This machine is made in four lengths of 40, 80, 120, and 240 inches. The 40-inch machine is shown in the illustration.

The measuring elements of this machine consist of a graduated glass rule and an "Optimeter," which is an optical indicator. The graduations are brought into plain view through the aid of a microscope, and the deviation from nominal values is determined by means of the "Optimeter." The microscope and the "Optimeter" tube are placed beside each other, so that the operator can take all readings from one position.

Graduation of the glass rule is accomplished by the aid of light wave interference, and the accuracy thus obtained is claimed to be so high that



Zeiss Optical Precision Measuring Machine

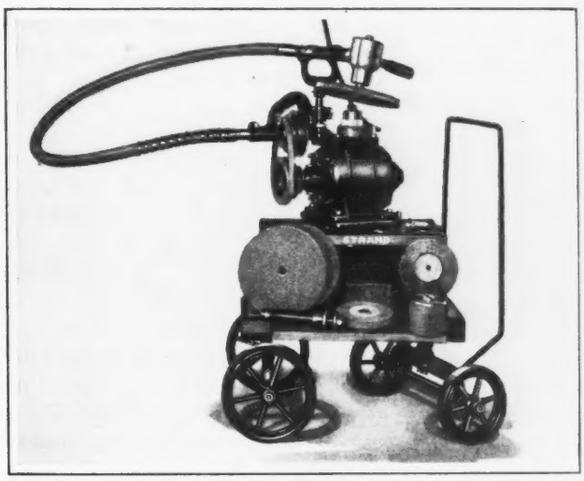
over a range of 4 inches, the error will not exceed 0.00005 inch. The glass rule has 800 graduations 0.005 inch apart, while the scale of the "Optimeter" is sub-divided to 0.00005 inch. Readings of 0.00001 inch are safely estimated. The measuring pressure is kept uniform by this optical indicator at about 7 ounces, independent of the skill of the operator. The anvils are made of agate, and are adjustable for parallelism.

At intervals of 4 inches, glass marks are embedded in the frame of the machine. Settings from one 4-inch mark to another are made by means of the optical system which travels with the headstock. While with former designs the machine had to be more than twice the greatest length to be measured, in the new type, the bed exceeds this length only by the amount required for the headstock and the tailstock. The optical system, though placed beside the work, avoids errors caused by unparallelism of the work and graduations. Inaccuracies or wear of the bed ways cannot affect the measuring accuracy of the equipment.

This machine will be shown at the tenth National Metal Exposition to be held at Philadelphia, Pa., from October 8 to 12, inclusive.

STRAND AUTOMOBILE BODY AND FENDER FINISHING MACHINE

Portable equipment intended primarily for finishing automobile bodies and fenders in repair shops has recently been placed on the market by



Strand Portable Equipment for Finishing Automobile Bodies and Fenders

N. A. Strand & Co., 5001-5009 N. Lincoln St., Chicago, Ill. The machine is driven by a 1/2-horsepower motor, which may be operated from a lighting circuit or a power line. The attachments are all interchangeable with the flexible shaft drive provided, and consist of a ball-bearing right-angle sanding attachment fitted with a 9-inch flexible felt pad; a 4- by 3-inch rubber polishing drum; a 6-inch wire cleaning brush; a 6- by 3/4-inch grinding wheel; a three-speed motor countershaft; and 6 feet of vulcanized rubber-covered flexible shaft with a grinding spindle. The machine is mounted on a four-wheeled truck having a built-in tool-box and a swivel baseplate.

This equipment may also be used in many other grinding and polishing operations, and attachments can be furnished for drilling, nut-setting, screwdriving, rotary-filing, etc.

"FUZON" ARC WELDER AND ELECTRODE-HOLDER

A gasoline-engine driven arc welder mounted on a frame provided with wire wheels and pneumatic rubber tires so as to make it readily portable, has recently been brought out by the Fusion Welding Corporation, 103rd St. and Torrence Ave., Chicago, Ill. This welder can be conveniently taken wherever an automobile can be driven. The front wheels

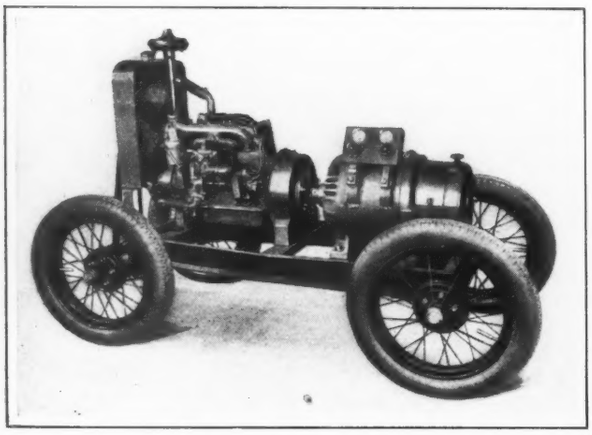


Fig. 1. "Fuzon" Portable Gasoline-engine Driven Arc Welder

turn with the handle. As the center of gravity is low, the equipment will not overturn when taken over rough ground, and so it is particularly suitable for use in pipe-line welding and in repair jobs around big plants.

In addition to the portable feature, an advantage claimed for the outfit is an easily controlled welding arc. It is stated that patented inter-pole connections in the generator put an inherently stabilized current in the welding line and give an unusual arc action. At the same time, induction coils, reactors, etc., are unnecessary to help stabilize the arc. A single-brush shifting control that is calibrated in amperes gives an infinite number of possible current settings. A Continental gasoline engine of 23-horsepower capacity is provided for the 200-ampere set, and a 40-horsepower engine for the 300-ampere set.

The same concern has also recently brought out a new electrode-holder of the type shown in Fig. 2,

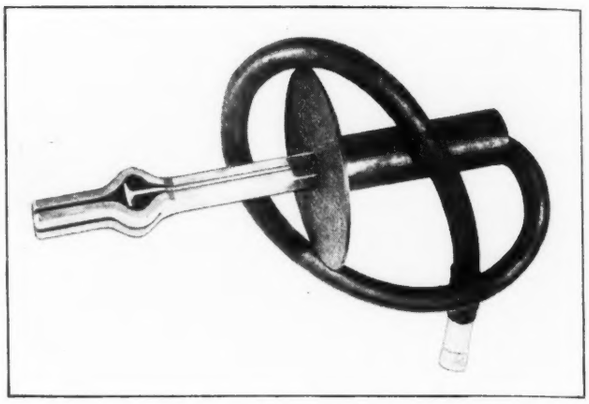
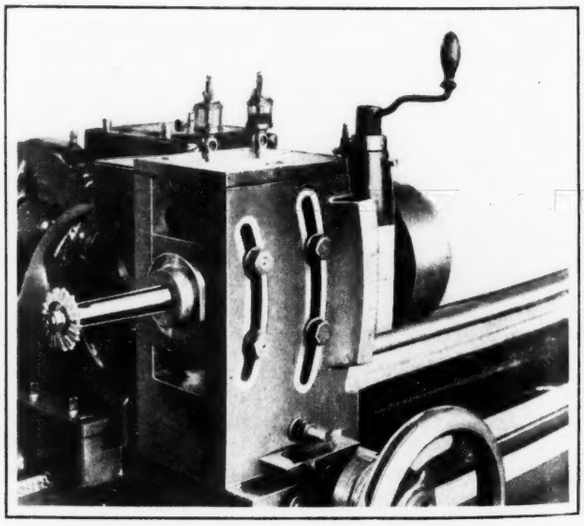


Fig. 2. Electrode-holder for Metallic Arc Welding

for metallic arc welding. The act of inserting an electrode in this holder automatically scrapes off any insulating material that may be present on the welding rod, thus insuring four clean points of firm contact and minimizing overheating of the electrode. The jaws are made of the special copper alloy that is used to support and attach trolley wires to the cross wires. This alloy resists arcing, which is the principal source of damage to most holders. When an electrode has been inserted between the jaws, it may be placed at any angle to facilitate its use in difficult welding positions.

INTERNAL MILLING HEAD FOR PRATT & WHITNEY THREAD MILLERS

Internal milling and hobbing operations can now be performed on the 6- and 10-inch sizes of model B thread millers built by the Pratt & Whitney Co., Hartford, Conn., by means of a milling head recently developed by that concern. This head virtually converts the thread millers into universal machines, as external milling and hobbing are performed by the regular cutter-head. One thread miller complete with the new head eliminates the necessity of having one machine for external work and another for internal work. In addition to this saving, the internal milling head is geared to give a cutter-spindle speed practically double that of the cutter-spindle of the external milling head.



Internal Milling Head Applied to a Pratt & Whitney Thread Miller

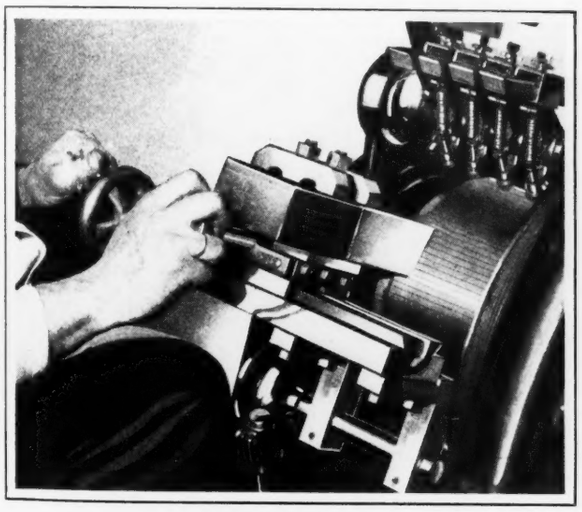
This increased speed is possible chiefly because of the fact that small milling cutters can be used on almost all internal work.

The base of the internal milling head is dovetailed to fit on the cross-slide with the regular external cutter-head, and the arrangement is such as to permit the use of the cross-slide handwheel for the simultaneous transverse movement of the external and internal heads. Power is supplied to the internal milling head by a gear mounted on the cutter-spindle shaft of the external cutter-head and two intermediate gears. The spindle of the internal milling head is equipped with a flywheel.

Adjustment is provided for setting the cutter at any angle up to 10 degrees above or below the center line. The desired angle can be conveniently obtained through graduations on the side of the milling head. Tie-rods hold the cutter-arbor at any angle. The angular settings are of considerable advantage in milling either right- or left-hand threads.

TOOL-REST FOR COMMUTATOR RESURFACERS

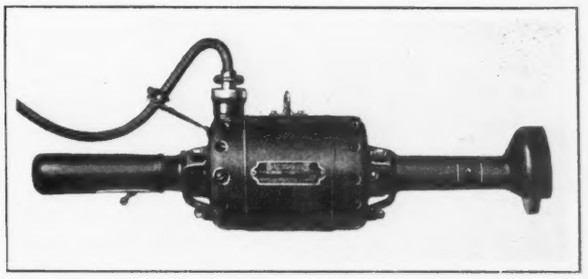
A tool-rest has been brought out by the Ideal Commutator Dresser Co., 1101 Park Ave., Sycamore, Ill., for use in conjunction with commutator resurfacers. This "Perfect" tool-rest is equipped with stones for removing long flat spots and any eccentricities in commutators. With this device there is no danger of gouging work. It is simple in construction and portable. Bases are available in lengths of from 6 to 28 inches, varying by 2 inches. Stones 2 by 2 inches in face or smaller, and of any length, can be used.



Tool-rest for "Ideal" Commutator Resurfacers

"DUMORE" HAND GRINDER

A No. 4 "Dumore" portable grinder equipped with a 1/4-horsepower ball-bearing universal motor is the latest product to be added to the line of electrical tools and appliances made by the Wisconsin Electric Co., 25 Sixteenth St., Racine, Wis. This tool is particularly useful in automobile plants for such operations as preparing the tops of die blanks so that toolmakers can quickly lay out their work.



"Dumore" Portable Electric Grinder

It is also used for grinding and polishing irregular shaped hardened forging, forming, and molding dies. For polishing operations, the emery wheel can be replaced with emery or sand paper disks. The tool is also useful for preparing parts for welding, and for grinding and smoothing completed welds. Equipped with a scratch-brush in place of the emery wheel, the device can be used for removing carbon from automobile engines, cleaning up rusty surfaces, etc.

The motor operates at 12,000 revolutions per minute, and because of this high speed, wheels larger than 2 1/2 inches in diameter should not be used unless they have an elastic or rubber bond, in which case it is possible to use wheels as large as 3 inches in diameter. Emery wheels ranging from 3/8 to 1 1/4 inches in thickness can be employed. This hand grinder is 19 1/2 inches long over-all, and weighs twelve pounds.

CUTLER-HAMMER MAGNETIC CONTACTOR AND REGULATING RHEOSTAT

An alternating-current magnetic contactor designed especially for automatically controlling lighting and power circuits in miscellaneous applications is being placed on the market in a complete line by the Cutler-Hammer Mfg. Co., 1204 St. Paul Ave., Milwaukee, Wis. Features of the contactors in this line include high-efficiency hammer-head type magnets with a self-aligning armature; a continuous-duty magnet coil; hardened steel bushings; tin-dipped solid-copper contacts; magnetic blow-outs; and chimney-type arc shields. The large sizes have the magnet frame supported on a spring plate which absorbs the shock of the magnet in closing. Two-, three- and four-pole types, with a capacity ranging from 20 to 150

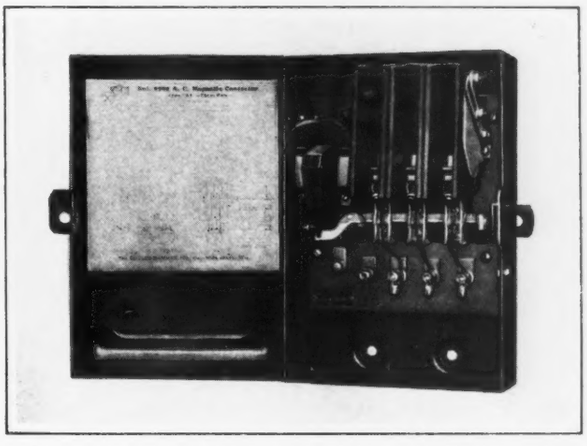


Fig. 1. Cutler-Hammer Alternating-current Magnetic Contactor

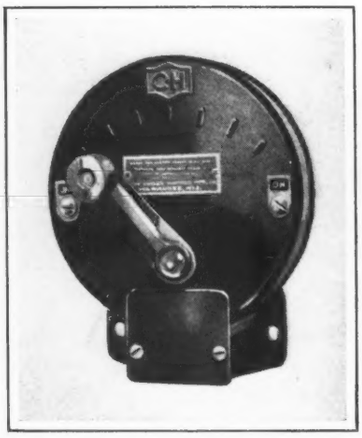


Fig. 2. Regulating Rheostat for Fractional-horsepower Motors

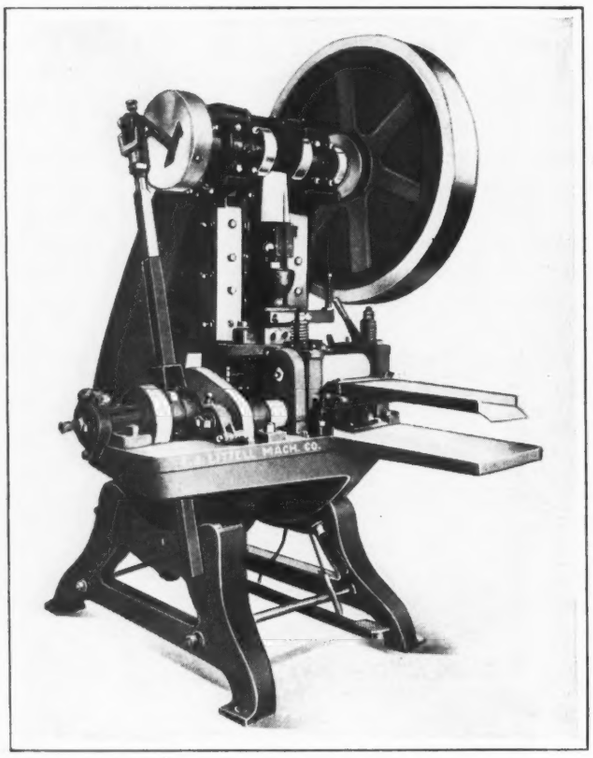
amperes, are made. They are supplied in a split enclosing case, as shown in Fig. 1, or on a slate panel for switchboard mounting.

Another recent product of the same concern is the regulating rheostat shown in Fig. 2, which can be used for controlling the speed of fractional horsepower motors driving small blowers, fans, buffers, and similar apparatus. The device is small in size to permit mounting directly on machines or in out of the way places. An enclosing case with an outside operating lever protects the unit and prevents accidental contact with live parts.

LITTELL PUNCH-PRESS FEED

A punch-press feed that will handle stock up to 8 1/4 inches wide and feed up to 28 inches of stock is the latest development of the F. J. Littell Machine Co., 4125-27 Ravenswood Ave., Chicago, Ill. The principal feature of this new mechanism is its ability to feed desired amounts of stock with accuracy. The feed illustrated shows a variation of less than 1/32 inch in feeding 28 inches of stock. It is designed for radiator work or any work requiring light stock and comparatively long feeding.

The mechanism is of the front-to-back type and of rack-and-pinion design. It can be used on straight-sided or double-crank presses.



Punch Press Equipped with New Littell Feed

BROWN & SHARPE MICROMETERS FOR MEASURING FORMING TOOLS

Special micrometers designed for measuring forming tools have recently been placed on the market by the Brown & Sharpe Mfg. Co., Providence, R. I. The micrometer shown in Fig. 1 is provided with disks on its anvil and spindle end to permit taking measurements on forming tools in places where regular micrometers cannot be applied. The disks are 1/2 inch in diameter, 1/16 inch thick in the center, and 0.020 inch thick at

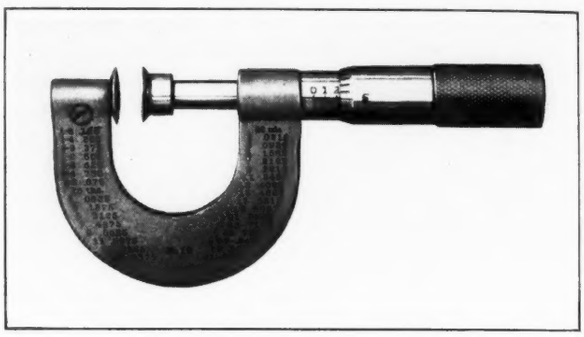


Fig. 1. Brown & Sharpe Micrometer with Special Disks on the Anvil and Spindle End

the outer edge. The measurement of a form up to 1/8 inch deep and over 0.020 inch wide can be taken with this instrument. One size of this micrometer is made, for measuring from 0 to 1 inch in thousandths of an inch.

The thin blade ends provided on the anvil and spindle of the micrometer caliper shown in Fig. 2

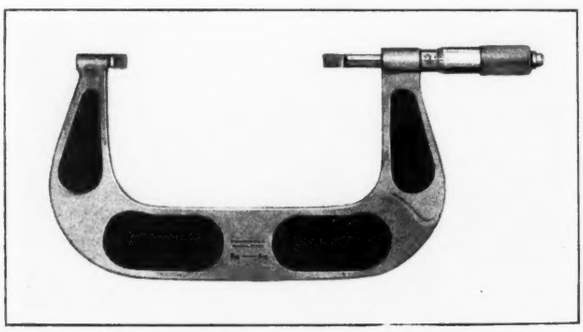


Fig. 2. Blade-anvil Micrometer for Measuring Diameters of Forming Tools and Slot Depths

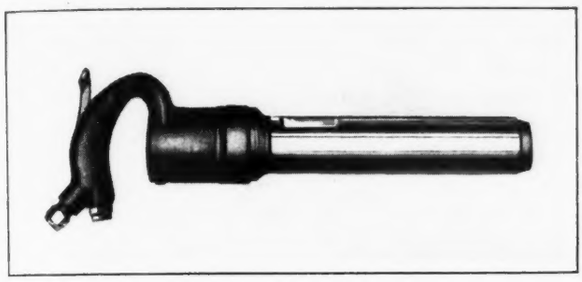
easily enter the narrow slots and grooves of the forming tools. The thin blades are 0.030 inch thick and permit measurements to be taken in slots or grooves up to 7/32 inch deep. By the use of this micrometer, the diameters of forming tools can be accurately measured and the depths of forms and grooves determined. It is made in sizes for measuring from 1 to 4 1/2 inches, in thousandths of an inch.

INGERSOLL-RAND PNEUMATIC RIVETING HAMMERS

A new line of air-operated riveting hammers consisting of four sizes having strokes of 5, 6, 8, and 9 inches, respectively, has recently been developed by the Ingersoll-Rand Co., 11 Broadway, New York City. An important feature of these hammers is that the handle is screwed on the barrel and a spring lock not only prevents the handle

from unscrewing, but also applies tension which automatically tightens it.

The valve operates in a hardened and ground box, which is located at the head of the barrel and clamped in place by the handle. The valve box has a solid upper end which provides a positive compression chamber for the piston on its up stroke, and thus the piston is always prevented from striking the handle end. The air cushion is not dependent upon an air-tight joint between the handle



Riveting Hammer of New Ingersoll-Rand Line

and the barrel. An open-type outside trigger handle is furnished as standard, but closed- or inverted-type handles can also be supplied.

BLANCHARD SEGMENT ABRASIVE WHEEL

A segment wheel having six abrasive segments fastened in position by three clamping devices has been brought out by the Blanchard Machine Co., 64 State St., Cambridge, Mass., for application to

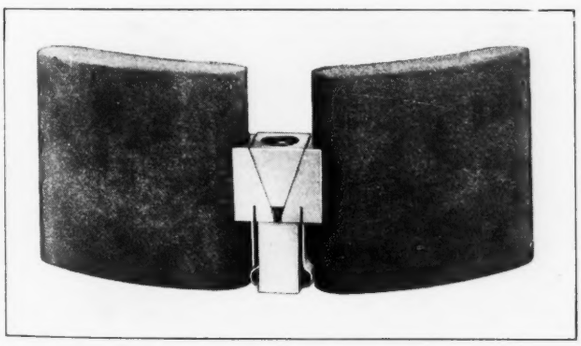


Fig. 1. Two Abrasive Segments and their Clamping Device

No. 16 Blanchard surface grinders of the direct motor-driven type. Savings in abrasive costs are claimed for this wheel in grinding a large variety of work having surfaces of medium or broad width. Cooler and faster cutting are other advantages cited.

The wheel chuck body is machined from a solid steel forging and is rustproofed. In Fig. 2 the wheel is shown with two abrasive segments withdrawn from the chuck so as to expose the pocket which receives them and the single clamp that holds them in position. The three fixed abutments and the three clamping units are made of aluminum bronze. The screw in each clamping unit is made of stainless steel.

The abrasive segments have rounded ends that match the fixed abutments and self-aligning shoes of the clamping devices. The segments are self-aligning. When either clamping screw is tightened, the corresponding segments are forced outward against the machined surface of the chuck body and against the fixed abutments. With this construction, a large area takes the clamping pressure.

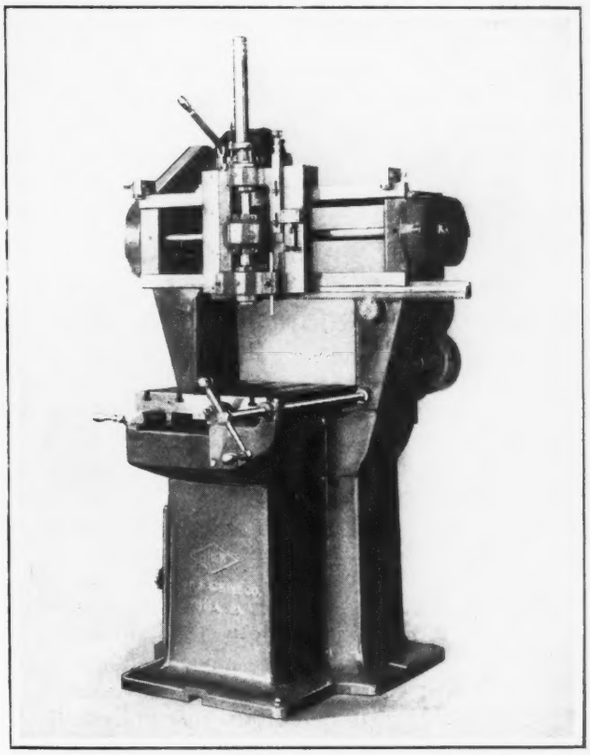
Fig. 2. Blanchard Segment Abrasive Wheel

The abrasive segments are 6 inches deep when new, and over 5 inches of the depth can be used. As they wear down, the segments can be conveniently set out to make a 2-inch section protrude from the chuck. This segment wheel is 18 inches in diameter.

FREW PROFILING AND MILLING MACHINE

A No. 6 heavy-duty profiling machine which can also be used as a vertical miller has been placed on the market by the Frew Machine Co., 132 W. Venango St., Philadelphia, Pa. The spindles of this machine are driven by hardened and ground spiral gears. The spindle slide is provided with a guide pin, so that parts can be made from a master form. The slide is bored to receive two former pins so that a master form can be made by using a sample piece in the work position. One or two spindles can be provided.

Vertical motion of the spindles is controlled through a hand-lever, there being a spring counterbalance for the weight of the slide. Cross adjustment is governed by means of a hand-crank at the



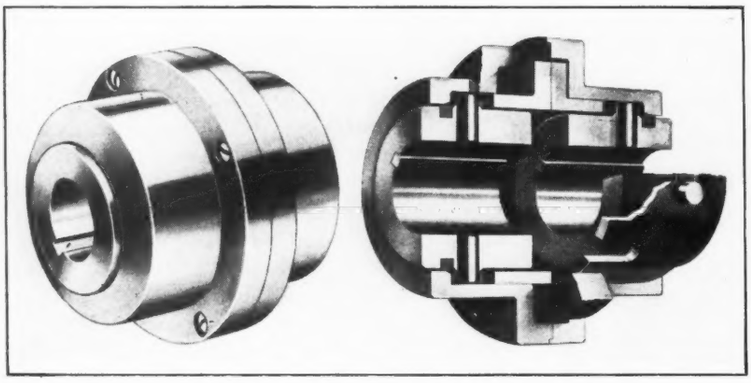
Frew Spiral-gear Driven Profiling and Milling Machine

front of the machine, and the longitudinal movement of the table by means of a hand-crank on the left-hand side of the bed. This crank may be provided on the right-hand side of the bed when desired.

Some of the important specifications of the machine are as follows: Working surface of table, 24 by 20 3/4 inches; movement of table, 24 inches; movement of cross-slide, 27 inches; vertical movement of spindles, 4 inches; maximum height between table and cross-slide, 11 1/4 inches; and weight of machine, approximately 2800 pounds.

"FLEX-RING" FULL-FLOATING COUPLING

A full-floating flexible coupling which is similar in design to the universal joint, with a shock absorbing member added, is being introduced on the market by the T. L. Smith Co., Milwaukee, Wis. This "Flex-Ring" coupling is claimed to compensate for such conditions in a direct drive as angular misalignment of shafts, offset between shafts, end play of shafts, and shock.



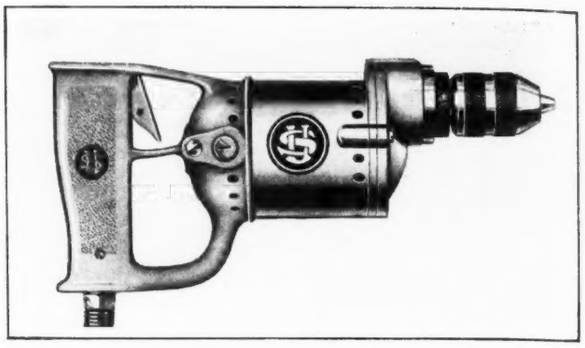
"Flex-Ring" Full-floating Flexible Coupling

Torsional load is transmitted through one or more ring-shaped springs made of alloy steel. These springs are not subjected to wear from endwise motion of the shafts nor from angular or offset misalignment, since they are confined in a housing that eliminates all motion except opening and closing under stress. For a reversing drive, it is unnecessary to increase the size of the "Flex-Ring," since there is no reversal of stresses in the torque elements.

UNITED STATES HIGH-SPEED PORTABLE ELECTRIC DRILL

The high-speed light-weight 1/4-inch portable electric drill here illustrated has recently been brought out by the United States Electrical Tool Co., 2477 W. Sixth St., Cincinnati, Ohio. This drill is made in two types. One is known as the "Special Direct Drive" drill; this type operates at a speed of 10,000 revolutions per minute and weighs only 4 pounds. The other type, known as the "Special Gear Reduction" drill, operates at 2000 revolutions per minute and weighs 1/8 pound more.

A feature of the drills is the keyless chucks with which they are equipped. Another advantage is the fact that they can be used in close places. Both drills embody a universal motor that operates on alternating or direct current. S. K. F. ball bearings are provided throughout. Chrome-nickel steel gears, a one-piece frame and commutator head, and a trigger switch, are also furnished.



United States High-speed Portable Electric Drill

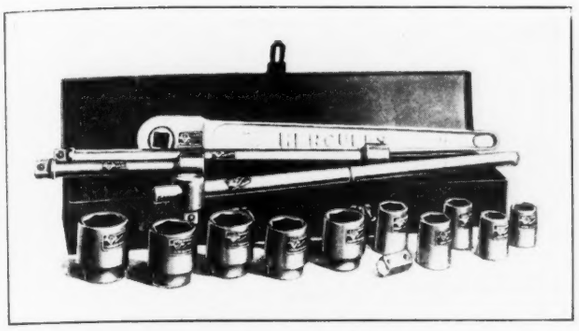
SPIRAL-BEVEL CUTTER TRUING FIXTURE

A fixture for truing up the circular cutters used in spiral-bevel gear generators built by the Gleason Works, Rochester, N. Y., has been designed by the same concern. In most cases, these cutters have heretofore been checked on the cutting machine. The new device not only releases the more expensive machines for production, but provides a more accurate and convenient means for doing this work. After the cutters are trued on the fixture, they may be placed on the machine and used without further checking, if the cutter-spindle runs true.

The truing fixture consists of a spindle made to accommodate various sizes of cutters. A handwheel attached to the spindle is used for turning the cutter to the desired point of checking. The spindle is locked in position by means of a lever. This lock is also used when a cutter is placed on the spindle or removed. The spindle is mounted on ball bearings and is ground in its ownbearings,the run-out being within 0.00005 inch.

Several different measuring instruments may be used in connection with the fixture, all of which read to 0.0001 inch. A finger device, operated through a system of levers, enables one indicator to be used for checking both inside and outside cutting blades.

Gleason Fixture for Truing Spiral-bevel Gear Cutters



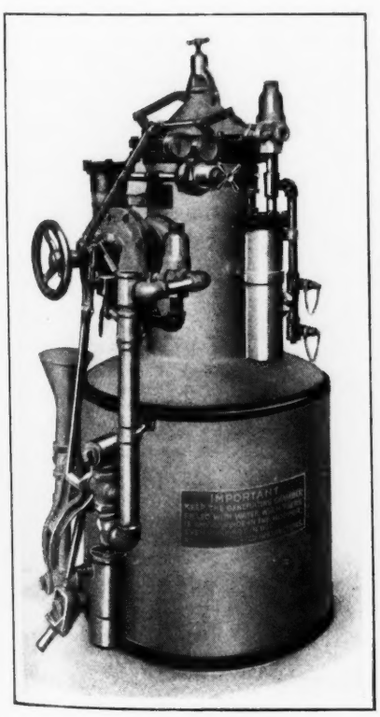
Heavy-duty Socket Wrench Set Made by the Bonney Forge & Tool Works

"HERCULES" SOCKET WRENCH SET

A new heavy-duty set of socket wrenches made of chrome-vanadium steel is being introduced to the trade by the Bonney Forge & Tool Works, Allentown, Pa., under the trade name "Hercules." This set comprises ten sockets, having openings ranging in size from 15/16 to 1 5/8 inches. In addition to the sockets, there is a ratchet handle and a sliding T-handle with short and long extensions. The set is packed in a black enameled carrying case.

"OXWELD" MEDIUM PRESSURE TYPE ACETYLENE GENERATORS

Three medium pressure type acetylene generators for welding and cutting operations have recently been placed on the market by the Oxweld Acetylene Co., 30 E. Forty-second St., New York City. The type MP-2 generator is made in two sizes having a 50- and 100-pound carbide capacity, respectively, and replaces the earlier medium pressure generator. The type MP-3 generator has a 300-pound carbide capacity.



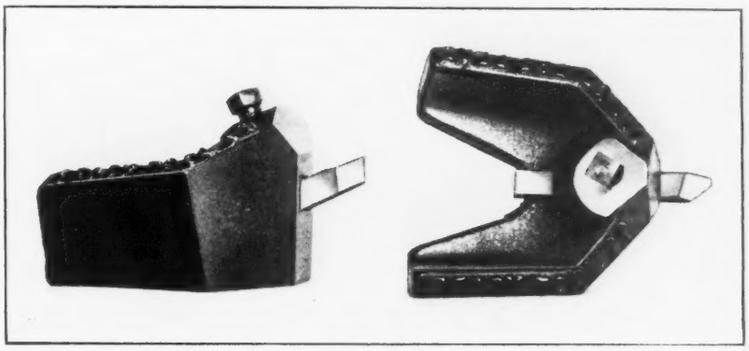
Oxweld Acetylene Generator

The feed mechanism of the type MP-2 generator has been redesigned to make the carbide shut off positively in case the diaphragm breaks or zero pressure exists in the generator due to any other cause. A new regulator, is used instead of the previous line regulator, the new regulator having a large stem and seat to provide ample capacity. It is equipped with two gages, one of which indicates the pressure in the generator, and the other the pressure in the delivery line.

The type MP-3 generator has been designed with a view to providing a pressure type generator of large capacity that would supply gas with a minimum pressure fluctuation and with minimum maintenance expense. The same principle of carbide feed is used as in the "Oxweld Balance Seal" generator, this feed being driven by a motor that is actuated by a weight.

"RED-E" TOOL-BIT GRINDING FIXTURE

A small fixture which facilitates the grinding of tool bits with proper clearance angles and desired shapes has recently been brought out by the Ready Tool Co., Iranistan Ave., Bridgeport, Conn. This fixture is designed to be used on the rest of any tool grinder for holding a tool bit against the periphery or side of a grinding wheel. It is intended that the rest be so positioned that a horizontal center line passing through the front edge of the tool bit will coincide with the horizontal axis of the wheel. Tool bits can be ground to any shape for use in a lathe, shaper, boring mill, etc.



Tool-bit Grinding Fixture Made by the Ready Tool Co.

With this fixture, an operator can hold tool bits at a definite angle in contact with the wheel, which is next to impossible when a bit is held in the fingers of an operator. The tool bit is clamped in the fixture at an angle of 27 degrees with the fixture base. When the tool is mounted in a toolholder at an angle of 20 degrees, a 7-degree clearance angle is thus automatically obtained on the front of the bit. In the illustration, the view at the left shows the fixture seated on its base as held on the rest of a grinder for grinding a bit to the desired form.

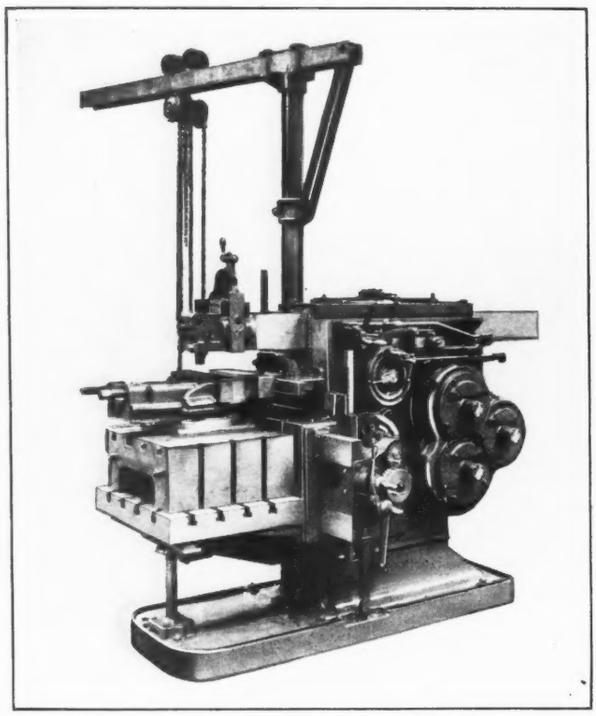
By placing the fixture on its right side and grinding the top of the tool bit against the periphery or side of the wheel, a 7-degree side slope is obtained on top of the bit for a right-hand tool and the bit can be ground with any amount of back slope that the operator desires. By turning the fixture on its left side and grinding the top of the tool bit, a 7-degree side slope is obtained on top for a left-hand tool and any desired back slope can again be obtained. The right-hand view in the illustration shows the fixture resting on its right side.

The fixture is so constructed that after a rest has been properly set, the intersection of the center lines on the front edge of the tool bit will be in the same plane as the horizontal axis of the

wheel, regardless of whether the fixture rests on its base or on either side. Two sizes of this fixture are made, a No. 1 size, which accommodates 5/16- and 3/8-inch tool bits, and a No. 2, which handles 7/16-, 1/2- and 5/8-inch bits.

MORTON HIGH-DUTY DRAW-CUT SHAPER

A high-duty draw-cut shaper of 32-inch stroke has been added to the line of machines built by the Morton Mfg. Co., East Broadway and Hoyt St., Muskegon Heights, Mich. This machine follows the same general design as the larger shapers built by the company, but embodies several improvements. The lower table and its outer support are of new design. The table is of the angle bracket type, and is located low on the saddle so as to give 31 1/2 inches of clearance between the ram and the table. This design makes it possible to handle bulky castings on the machine. The lower table is supported at the outer end by an automatically adjusted support secured directly to the cross-rail of the machine. It is raised and lowered by means of vertically adjustable screws which operate in independently adjustable nuts bolted to the extension base. Two vertical feed-screws are used.



Morton 32-inch High-duty Draw-cut Shaper

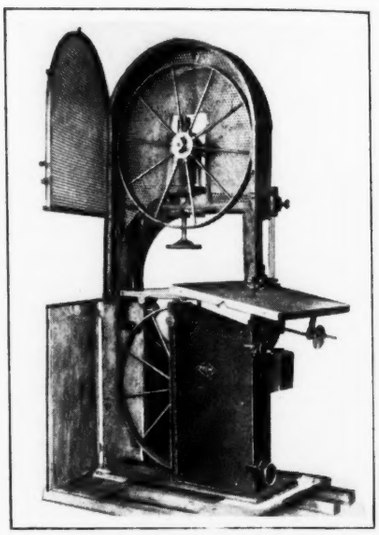
The ram measures 6 by 6 1/2 inches, and is made from a high-carbon steel forging. It has a bearing surface on all four sides through the entire length of the column, and is threaded on one end to receive the cutting head. There is a new friction feed of the automatic relieving type, constructed with a large friction surface.

A power rapid traverse is incorporated in the design, as has been the practice for twenty years. The splash system of oiling is used for clutches and all shaft journals subjected to heavy strains.

The machine is equipped with a crane and hoist of the two-speed type and of 1/2 ton capacity. The swivel base vise has a maximum opening of 14 inches, and the T-slotted top plate has an upper surface of 28 by 32 inches. Either a belt or motor drive can be furnished. The machine will accommodate various attachments for railroad shop work.

COLLADAY BALL-BEARING BAND SAW

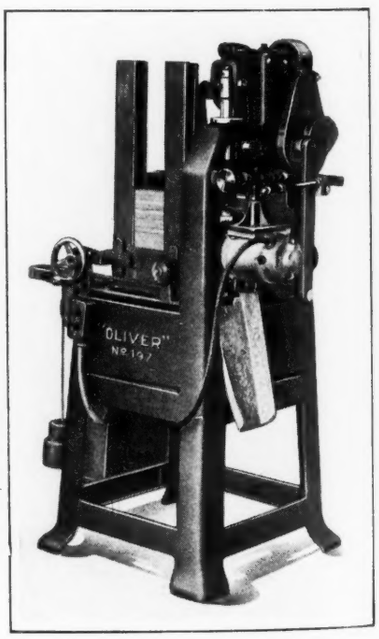
A 36-inch band saw equipped throughout with ball bearings and having a blade speed of about 63 feet per minute is being introduced to the trade by the Colladay Machine Works, Hope and Venango Sts., Philadelphia, Pa. The table of this machine is 27 inches wide, 35 inches long, and tilts to an angle of 45 degrees, being operated by means of a conveniently placed handwheel. The top wheel is equipped with a spring tension device and is adjustable for lining up the saw. The guide bar has a spring counterbalance and supports a frictionless roller guide. A belt drive or two types of motor drive can be furnished. The weight of the belt-driven machine is 1750 pounds, and of the motor-driven machine, 1950 pounds.



Colladay Ball-bearing Band Saw

OLIVER WEDGE-CUTTING MACHINE

Wooden wedges of the type frequently used by the metal-working industry can be manufactured in a No. 197 automatic wedge producer recently brought out by the Oliver Machinery Co., Grand Rapids, Mich. The particular machine illustrated was built for making wedges that are inserted in the windings of motors. The machine is regularly built to produce wedges up to 3 inches long and 1 1/8 inches wide, varying in taper from nothing at one end to 1/2 inch thick at the opposite end. Two motors operate

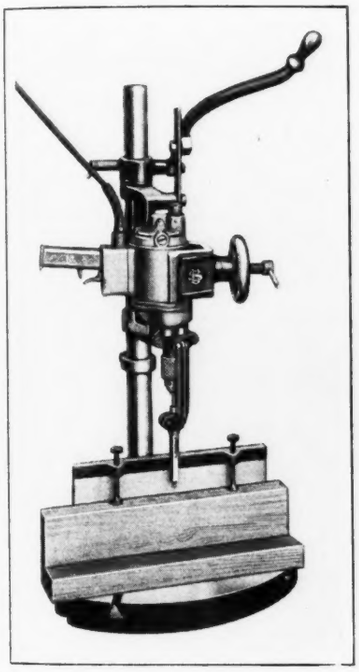


Oliver Automatic Wedge Producer

the machine, the one delivering power to the feed mechanism and the other driving the saw. The feed mechanism is adjustable to receive stock 10 inches wide and in various lengths along the grain up to 3 inches. Cutting is accomplished by a high-speed saw 7 inches in diameter.

U. S. BENCH MORTISER AND DRILL

A double-duty tool which serves both as a drill for either portable or bench use and as a bench mortiser is being introduced to the trade by the United States Electrical Tool Co., 2477 W. Sixth St., Cincinnati, Ohio. This device drills holes up to 2 inches in diameter in wood and up to 1/2 inch in diameter in steel. It mortises nine sizes of holes from 1/4 to 3/4 inch across, and up to 5 1/2 inches deep. It runs at 450 R.P.M. under load on either alternating or direct current.



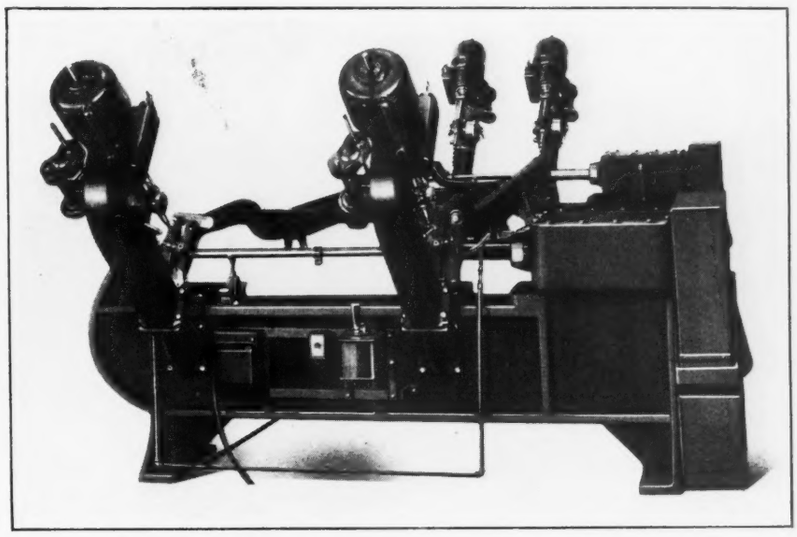
Bench Mortiser and Drill

The drill is equipped with ball bearings and has a two-pole trigger switch. The stand, a 3/8-inch hollow chisel and bit, and collars for holding from 1/4- to 3/4-inch chisels, are regularly furnished.

HANNA CHASSIS-FRAME ASSEMBLY PRESS

An assembly press now being introduced on the market by the Hanna Engineering Works, 1763 Elston Ave., Chicago, Ill., is designed to be an important adjunct to chassis-frame riveting installations when one or more tubular cross-members must be pressed into horns or outriggers previously riveted to the side-bar channel webs. The press rams open wide to permit quick loading of frame parts. The rams act in unison, advancing rapidly until they engage the side-bar channel, at which time the speed is automatically reduced. Stopping of the rams occurs automatically when the side-bar channels are properly spaced.

Standard drill heads drill holes for rivets which dowel the tubular cross-members in place. These drill heads are automatically fed forward for drilling, and are then returned automatically at a fast rate to the starting position. This chassis-frame assembly press is a self-contained unit equipped with a motor drive and limit switch controls. A pump is provided for delivering compound to the drills from a sump. Pressure pump lubrication of the mechanism is one of the important features of the machine.



Hanna Assembly Press for Chassis-frame Riveting Installations

PERSONALS

H. D. ROSENKRANS has been made district sales manager, with offices at 50 Church St., Room 1373, New York City, for the Niagara Machine & Tool Works, Buffalo, N. Y. Mr. Rosenkrans has been with this company nine years in the engineering, advertising, and sales departments.

W. E. TIERNEY has been appointed representative in the South and Southwest for the Botfield Refractories Co., Philadelphia, Pa., manufacturer of "Adamant" firebrick cement, "Adamant-Adachrome" and the "Adamant" gun. Mr. Tierney's headquarters will be in New Orleans.

AUGUST WILKS has recently joined the Kearney & Trecker Corporation, Milwaukee, Wis., as works manager. For the last five years Mr. Wilks has been production manager of the Hoover Vacuum Sweeper Co. at Canton, Ohio. C. M. CHEADLE, JR., has been appointed advertising manager.

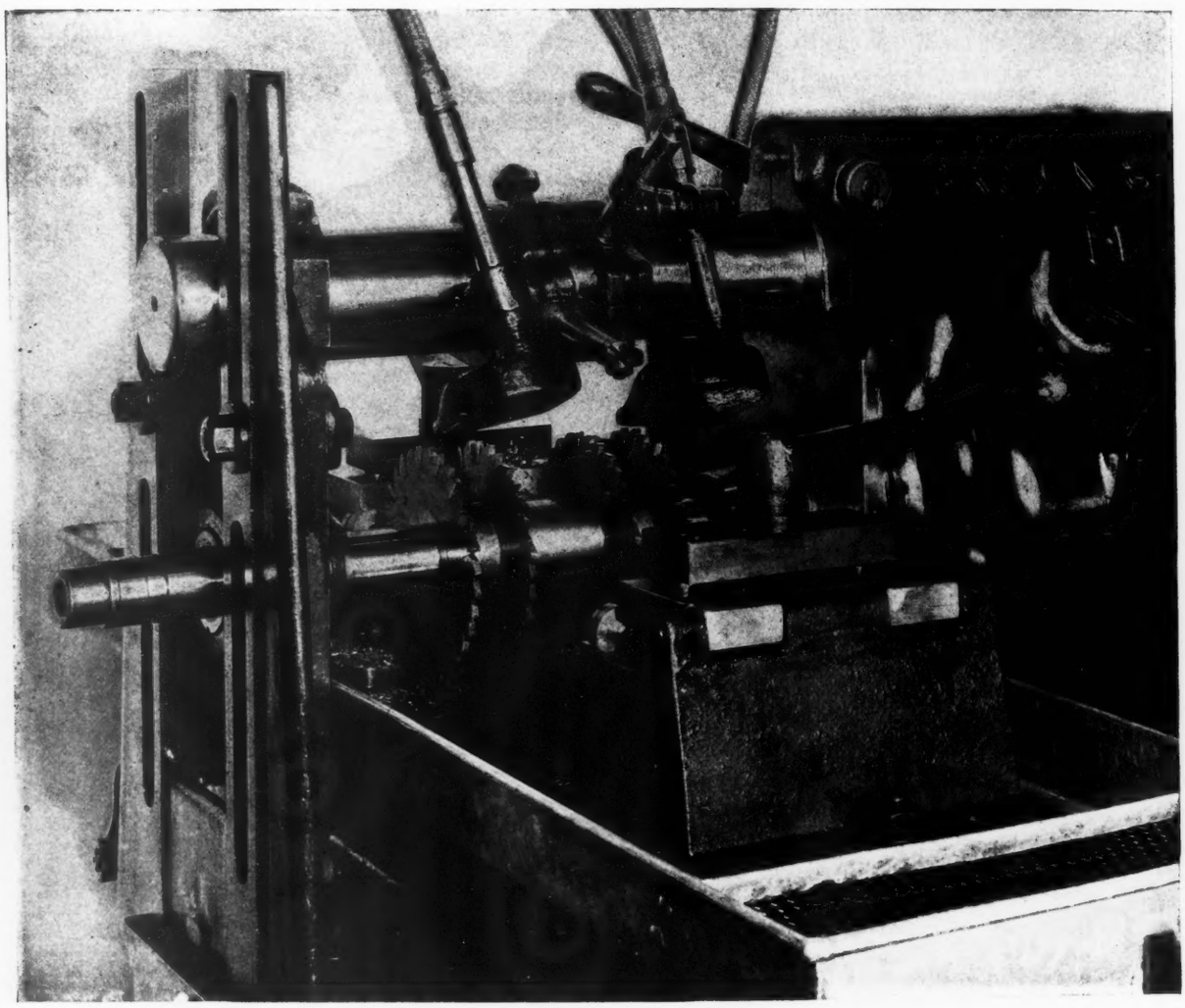
BERNHARD LESTER, assistant industrial sales manager of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has been placed in charge of the company's business relationships with architects, builders, building contractors, and manufacturers of machinery and motor-driven appliances. His headquarters are at 150 Broadway, New York City.

ALBERT WALTON, Melrose Park, Philadelphia, Pa., has been appointed eastern representative of the Gray Iron Institute. Mr. Walton will maintain headquarters in Philadelphia and will further the interests of the institute in the New England states and in New York and Pennsylvania. He has been engaged for several years in industrial engineering service.

L. P. HENDERSON, formerly of the Chicago office of the Lincoln Electric Co., Cleveland, Ohio, has been transferred and put in charge of the Minneapolis district. ROBERT NOTVEST has been transferred from Kansas City to Indianapolis, and will be in charge of that district. R. E. MASON will replace Mr. Notvest at Kansas City. N. L. NYE has been stationed at Akron, Ohio, under the direction of R. P. Tarbell, manager of the Cleveland district.

H. C. BUSCH, who has been president of the Cisco Machine Tool Co., Inc., Cincinnati, Ohio, since its inception, has retired, and RALPH B. BUSCH, vice-president, has succeeded him to the presidency. H. C. Busch was also president of the Cincinnati Iron & Steel Co., which was consolidated with Joseph T. Ryerson & Son, Inc., several years ago. He has been gradually withdrawing as the active head of four or five other large corporations in order to devote more time to travel and leisure.

LET FIGURES TALK



Brown & Sharpe Products

Milling Machines
Grinding Machines
Gear Cutting Machines
Screw Machines
Cutters and Hobs
Machinist's Tools
Gears Cut to Order

Brown & Sharpe cutters are put on this job, in an automobile factory, because costs have to be kept low and production high. With the operation fully automatic, the cutters shown in the illustration mill 4 pieces every 45 seconds and do it at the lowest real cutter cost.

on CUTTER COSTS—

the First Cost isn't the *Real* Cost

WATCH the performance record of your cutters. Consider the length of service, the number of sharpenings, the removals and set-ups of cutters which are necessary. Figure these costs and the cost of idle machine time. To these figures add the cost of lost production. When you check up final results, you'll find that the first cost isn't the real cost by any means.

For instance—a cutter which has a purchase price of $20.00 will often have an upkeep cost two, three or several times as great as the initial cost. In other words, the real cost of this particular cutter may be $40.00, $60.00 or even more.

Cold figures will prove to you that good cutters can save you time and money. BROWN & SHARPE CUTTERS give lowest cost when you figure real cost.

The Cost of

Time Lost Removing Cutters
Plus Time Lost Replacing Cutters
Plus Lost Production
Plus Sharpening Cutters
Plus Original Purchase
Equals
Real Cost of Cutters

What is the Real Cost of Your Cutters?

BROWN & SHARPE

BROWN & SHARPE MFG. CO.

PROVIDENCE, R. I., U. S. A.

Lubrication of Cylindrical Bearings

At the Machine Shop Practice Division meeting of the American Society of Mechanical Engineers held in Cincinnati, September 24 to 27, Forrest E. Cardullo, chief engineer of the G. A. Gray Co., Cincinnati, Ohio, read an unusually complete paper on the theory of the lubrication of cylindrical bearings, in which he presented a thorough analysis of all the factors involved in the problems met with in cylindrical bearing design. From the theory presented, he developed certain general rules regarding the design and operation of bearings. Assuming that the minimum lubricating film thickness is the most important of the factors that determine whether or not a bearing will operate successfully, he arrived at the conclusions embodied in the following rules:

1. The load carrying capacity of a bearing is proportional to its diameter.

2. The load carrying capacity is proportional to the operating viscosity of the lubricant, that is, to the viscosity of the lubricant at the temperature which the lubricating film attains in operation.

3. The load carrying capacity is proportional to the speed of rotation, in revolutions per minute.

4. The load carrying capacity of a bearing is proportional to the surface speed of the journal, since this is proportional to the product of the diameter and the speed in revolutions per minute.

5. The load carrying capacity of a bearing is a function of its length. For very short bearings, such as eccentric straps, it is proportional to the cube of the length. For very long bearings, it is proportional to the length. For bearings of the usual proportions, the load carrying capacity is proportional to some power of the length greater than the first and less than the third.

The power loss in a bearing depends upon the eccentricity ratio. With the same operating clearance, operating viscosity, and speed, a bearing with a high eccentricity ratio will have a greater power loss than one with a low eccentricity ratio. If we assume that the eccentricity ratio remains constant, we arrive at the following general rules:

6. The power loss in a bearing is proportional to the square of the diameter.

7. The power loss in a bearing is proportional to the length.

8. The power loss in a bearing is proportional to the square of the speed, in revolutions per minute.

9. The power loss in a bearing is proportional to the square of the surface speed of the journal.

10. The power loss in a bearing is inversely proportional to the operating clearance.

11. The power loss in a bearing is proportional to the operating viscosity of the lubricant.

The foregoing rules lead directly to the following conclusions regarding the ultimate rise in temperature of a bearing operating continuously:

12. The rise in temperature of a bearing is independent of its length.

13. The rise in temperature of a bearing is proportional to its diameter.

14. The rise in temperature of a bearing is proportional to the operating viscosity of the lubricant.

15. The rise in temperature of a bearing is proportional to the square of the number of revolutions per minute.

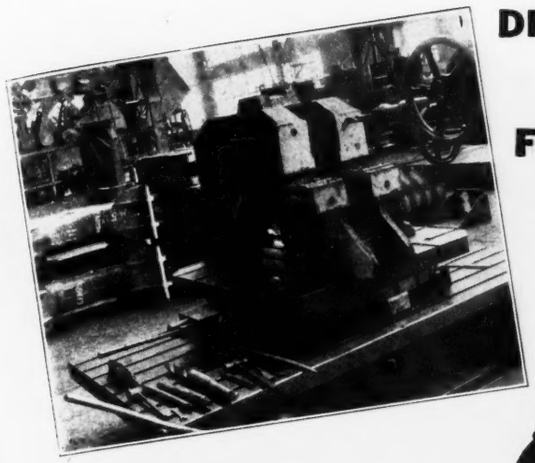
16. The rise in temperature of a bearing is proportional to the running clearance.

The sixteen rules for the general behavior of a bearing which have been given in the foregoing assume that all the factors except the one considered remain constant. However, two or more factors usually vary at the same time. These rules are therefore not to be taken as a numerical expression of the behavior of a bearing, but rather as a guide to the general effect of variations in these factors. For instance, a high-speed bearing usually has a larger running clearance than a low-speed bearing, so that although the increased speed tends to increase the power loss and the operating temperature, the increased running clearance tends to produce the opposite effect. In considering the effects of diameter, it must be remembered that bearings of large diameter have correspondingly large running clearance, and the rules regarding the effect of diameter and running clearance on power loss and operating temperature be read in the light of this fact.

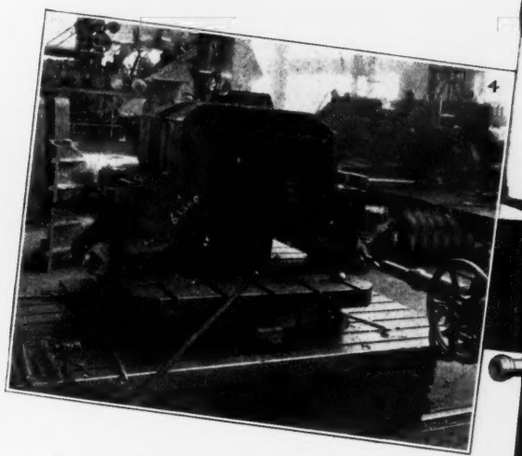
The rules also assume certain conditions that are never realized in practice, namely that the box and the journal are both truly round and perfectly smooth, that they are rigid and maintain their shape, and that their axes are parallel and not affected by deflections produced by the load. On account of the effect of deflection, an increase in the diameter of the bearing will be of greater practical value in increasing the load carrying capacity than the rules indicate, while an increase in the length of the bearing will be of less value than the rules indicate. Because of imperfections in roundness and uniformity, small operating clearances are less satisfactory than the rules would indicate.

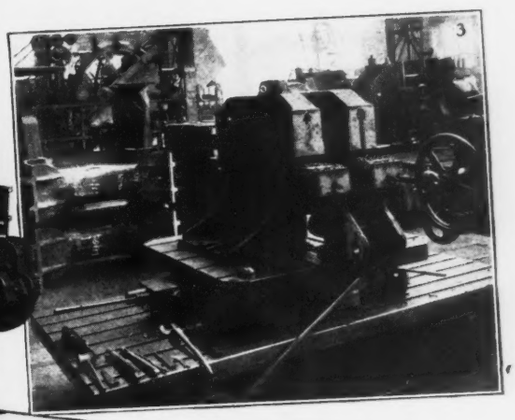
The phenomena which occur in the operation of a bearing are so complex, and the several variables are so interrelated, that only the most general conclusions can be drawn concerning the behavior of bearings from mathematical theory. When to these considerations we add the fact that practical bearings depart from their theoretical form, both because of imperfections of manufacture and lack of perfect rigidity in the parts, we find that their behavior is likely to be somewhat erratic, and the rules are indicative merely of the general trend of their behavior.

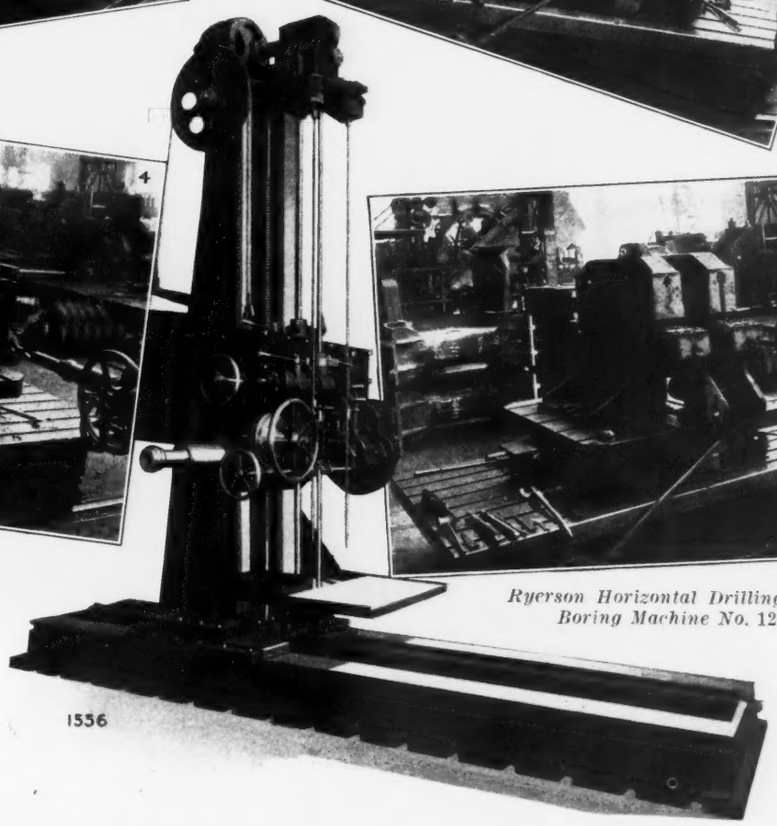
Those interested in a thorough study of the theory of cylindrical bearings and their lubrication may obtain copies of the paper by addressing the American Society of Mechanical Engineers, 29 W. 39th St., New York City.



DRILLED ON FOUR SIDES FROM THE ONE SET-UP







1472 lb. Steel Casting held by a bolt and strap through a hole in the center of the casting. Rear side against angle plate. Eight 1-5/16" holes drilled and back faced through 1¼" material. Four 1-25/32" holes drilled through 1¼" material.

Total drilling time, 4 operations, including setting from floor to floor—One Hour.

Ryerson Horizontal Drilling and Boring Machine No. 12.

Cut Your Floor-to-Floor Time

One simple set-up—then uninterrupted operation. The operator plants his feet in one spot—the work is right in front of him, and every control within easy reach. No climbing over and around odd-shaped castings all day. And you can handle anything in the shop—economically—with the Ryerson Horizontal Drills. The larger the piece the bigger the saving.

The Horizontal Drill simplifies the handling of difficult pieces. It gives you a wider range of operation and greater ease in handling the general run of work. It will show a big saving in floor to floor time.

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Drill it Horizontally

The British Metal-working Industries

From MACHINERY's Special Correspondent

London, September 18

WHILE little change is to be noted in the conditions prevailing in the metal-working industries as a whole, a general note of optimism is now apparent, which has been absent during past months and which may be regarded as heralding the advent of the usual autumn revival. That no definite improvement in the position has yet taken place is clearly evidenced by the continued increase in unemployment. Thus, despite the fact that a large number of unemployed miners are now in Canada engaged in harvesting work, the total number of persons on the registers of the unemployment exchanges on August 27 was 1,320,000. This total showed an increase of 11,840, as compared with the previous week, and was greater by 270,739 than the corresponding total last year.

With regard to the basic industry of coal mining, the situation cannot but be regarded with increasing apprehension. Thus in South Wales, during the three months of May, June, and July, from practically every standpoint, conditions were worse than during the preceding quarterly period, and in so far as production and volume of employment are concerned, there has been a retrogression to the position of twenty-five years ago. By comparison with 1913, the contraction of export trade alone entails a direct loss of revenue to the country of more than £9,000,000.

The Machine Tool Industry has a Great Exposition

In the machine tool industry, interest centers at the present time in the fourth Machine Tool and Engineering Exhibition which was formally opened at Olympia September 5 by the Rt. Hon. W. C. Bridgeman, M. P., First Lord of the Admiralty. Sir Alfred Herbert, president of the Machine Tool Trades Association, stated at the opening ceremony that the amount of space booked for the present exhibition was over 50 per cent greater than that filled at the last exhibition in 1924.

Perhaps the most striking feature of the exhibition was the very general application of individual motor drives to machine tools. The latest development in this direction is the use of built-in motors, so that the motor becomes virtually an integral part of the machine. Many machines were also shown fitted with hydraulic motions, a feature which, at the 1924 exhibition, was sufficiently rare to excite especial comment. It would seem safe to predict that the increasing application of hydraulic power to both rotary and reciprocating motions will prove to be one of the most important lines of development in machine tool design during the immediate future.

Both electric and hydraulic drives are also features which, in addition to simplifying the design of machines, facilitate the task of the operator and enable idle time to be reduced to a minimum. Generally this policy has been further carried out by the grouping and interconnection of controls and the provision, where possible, of magnetic tables and quick-acting work-holding fixtures.

Radical departures from standard practice are conspicuous by their absence, and are not indeed to be expected. The general design of the machine tools exhibited follows lines which have proved satisfactory in service for many years, and manufacturers have rightly concentrated on improving existing designs rather than on developing new ones.

Some of the New Machines Exhibited at Olympia

A few machines stand out as being of especial interest, and among these should be mentioned the new "Maxicut" lathes exhibited by Drummond Bros. Ltd., Guildford. These machines are shown in two sizes, the smaller one being suitable for work up to 12 inches long by 6 inches in diameter, while the larger machine will accommodate work up to 36 inches long between centers.

In the case of multi-tool lathes of this type, one of the greatest difficulties experienced in the past has been the provision of adequate steadyrests for the work. On the "Maxicut" lathes, the tools are carried on two or more separate slides at the front and rear of the bed, so that steadyrests can be applied at fairly frequent intervals. The rapid approach and return of the tool-slides is effected hydraulically, while in the case of the larger machine, the actual feed to both sliding and surfacing motions is effected by cam mechanism. Owing to the fact that several slides are employed which must be maintained in exact relation one with another, it was found impracticable to apply a hydraulic feed to this machine. The smaller machine, which employs only one slide at the front and rear, is fully hydraulic, the rate of feed being varied by means of a control valve. On both machines the tailstock spindle is controlled hydraulically, being brought forward to engage the work and then locked in position by a single hand-lever. In the case of the larger machine, as many as forty-four tools may be in operation on the work simultaneously.

Webster & Bennett Ltd., Coventry, exhibited a 48-inch duplex boring and turning mill which has been designed specifically with the object of taking the fullest advantage of the remarkable properties of certain new cutting steels and alloys, among which may be mentioned the S.O.B.V. cutting alloy made by Samuel Osborne & Co. Ltd., Sheffield, and "Widia" metal developed by Fried. Krupp A.-G., Essen. This machine will operate continuously on 45-ton tensile steel forgings, taking a 1/4-inch cut at a speed of 35 feet per minute with a feed of 1/8 inch per revolution.

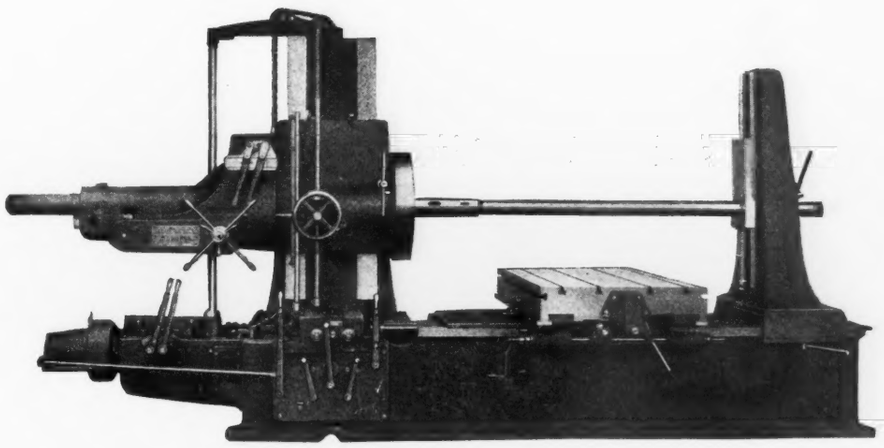
Assure profits by reducing labor turnover

Because of its accuracy, dependability, convenience and accident-proof features, operators like to run

The LUCAS

"PRECISION"

Boring, Drilling and Milling Machine



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Mechanical power is cheaper than human muscular energy.

THE LUCAS MACHINE TOOL CO., Cleveland, Ohio, U.S.A.

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry, Societe Anonyme Belge, Alfred Herbert, Brussels. Allied Machinery Co., Barcelona, Zurich. V. Lowener, Copenhagen, Oslo, Stockholm. R. S. Stokvis & Zonen, Paris and Rotterdam. Andrews & George Co., Tokyo, Ing. M. Kocian & G. Nedela, Prague. Emanuele Mascherpa, Milan, Italy.

TRADE NOTES

GRAY IRON INSTITUTE has established permanent headquarters in the Terminal Tower Building, Public Square, Cleveland, Ohio.

MERCO NORDSTROM VALVE CO., subsidiary of the Merrill Co., announces the removal of its San Francisco office to 343 Sansome St., San Francisco, Cal.

LINCOLN ELECTRIC CO., Cleveland, Ohio, has opened a new office in San Francisco, Cal., at 533 Market St., under the charge of W. S. Stewart. A complete stock of "Link-Weld" motors, "Stable-Arc" welders, and arc-welding supplies will be carried at the new office.

ROSS HEATER & MFG. CO., INC., Buffalo, N. Y., announces the opening of a branch office in Philadelphia at 121 N. Broad St., Room 305, with J. W. Spencer, Jr., in charge. Mr. Spencer has been associated with the New York office of the company for a number of years.

IDEAL COMMUTATOR DRESSER CO., 1011 Park Ave., Sycamore, Ill., manufacturer of commutator and motor maintenance equipment, announces that the company is now represented in the Rocky Mountain district by the Industrial Supply Co., 121-125 Motor Ave., Salt Lake City, Utah.

DIAMOND CHAIN & MFG. CO., Indianapolis, Ind., has completed plans and placed contracts for a large additional factory unit, four stories high, that will add 40,000 square feet of floor space to the plant. Reinforced concrete, fireproof construction, similar to that used in the present plant, will be employed.

CHARLES T. TOPPING MACHINERY CO., manufacturer of excavating machinery, announces the removal of its offices from the U. B. Building, Dayton, Ohio, to 4403 St. Clair Ave., Cleveland, Ohio. The company has also completed arrangements which will provide enlarged manufacturing facilities, with a view to expanding its production.

UNITED STATES ELECTRICAL TOOL CO., Cincinnati, Ohio, has opened a branch office at 1641 Stout St., Denver, Col., with L. B. Putnam in charge. This is the fifth United States sales office to be established in the West, the others being at Dallas, San Francisco, Los Angeles, and Seattle. In Dallas, J. R. Baumberger has been added to the organization.

ERIE CITY IRON WORKS, Erie, Pa., have appointed Alan G. Cary & Co. sales representatives of the company in St. Paul, Minn. A. G. Cary has been identified with mechanical and power plant equipment for many years, first being associated with the Robinson, Cary & Sands Co. of St. Paul, for sixteen years, after which he organized his own company to sell railroad, industrial, and power plant equipment.

BROWN INSTRUMENT CO., 4451 Wayne Ave., Philadelphia, Pa., maker of pyrometers, thermometers, flow meters, and indicating and recording instruments, is enlarging the building housing the company's boiler room and increasing the boiler capacity. Space will be provided for a complete steam plant of sufficient capacity to heat a building having a floor space equal to three times the building now occupied by the company.

BLISS & LAUGHLIN, INC., Chicago, Ill., has made plans for the erection of a new plant in Buffalo, N. Y., where a complete line of cold-drawn products, including screw stock, open-hearth steel, and special alloys, as well as turned and polished shafting and turned and ground shafting, will be manufactured. Walter R. Howell, vice-president and general manager of the company, will be in direct charge of the new plant.

LINCOLN ELECTRIC CO., Cleveland, Ohio, manufacturer of "Linc-Weld" motors and "Stable-Arc" welders, held a meeting of its salesmen from all parts of the United States and Canada at the company's research laboratories in Cleveland, September 14 and 15. Demonstrations and comparative tests were made of important new developments in electric arc-welding equipment, and a wide range of applications of the "electronic tornado" principle to electric arc-welding was demonstrated.

UNITED STATES AUTOMATIC BOX MACHINERY CO., 172-178 Green St., Jamaica Plain, Boston, Mass., manufacturer of automatic paper box machinery, announces that the company has purchased the patents covering the Boston universal angle-plate from the Boston Scale & Machine Co., Boston, Mass. The purchase includes all patterns, jigs, and fixtures for the manufacture of the angle-plate. The company also announces that it will move into its new plant at 459 Watertown St., Newtonville, Mass., during the month of October.

TIMKEN ROLLER BEARING CO., Canton, Ohio, announces the incorporation of a new company known as the Timken Steel & Tube Co., which will take over the manufacture and sale of Timken steel and tubing. The headquarters and mills are in Canton, Ohio, with sales offices in Chicago, Los Angeles, Detroit, and New York. The officers of the new company are H. H. Timken, chairman; M. T. Lothrop, president; J. W. Spray, vice-president; A. J. Sanford, vice-president in charge of sales; J. E. Daily, vice-president in charge of operations; and J. F. Strough, secretary and treasurer.

NIAGARA MACHINE & TOOL WORKS, 637-697 Northland Ave., Buffalo, N. Y., announce the opening of a new sales office at Room 1373, 50 Church St., New York City, with D. Rosenkrans as district sales manager. This office will serve the metropolitan district, including Fairfield County, Conn., New York City, and all of Jersey north of but not including Trenton, handling the company's complete line of power presses, punches, shears, flanging machinery, drum making equipment, and dies. A short time ago the company established offices at 617 Harrison Building, Philadelphia, Pa., and Park Building, Pittsburgh, Pa.

VANADIUM-ALLOYS STEEL CO., Latrobe, Pa., is making the following announcement: At a recent meeting of the board of directors of the company, a proposal, which later received favorable consideration, was made to the directors of the Colonial Steel Co., of Pittsburgh, Pa., whereby shares of stock of the Colonial Steel Co. are to be exchanged for shares of stock of the Vanadium-Alloys Steel Co. A meeting of the stockholders of the Vanadium-Alloys Steel Co. has been called to approve the action of the directors. No changes in the management of the Colonial Steel Co. are contemplated, except that the sales of the products of the two companies will be coordinated. George P. Rhodes, T. Howe Childs, and S. Clarke Reed will be the representatives of the Colonial Steel Co. on the board of directors of the Vanadium-Alloys Steel Co.

OBITUARY

PAUL ARMSTRONG, president and one of the founders of the Armstrong Bros. Tool Co. and Armstrong-Blum Mfg. Co. of Chicago, died at his home in River Forest, Ill., on September 20 in his sixty-sixth year. Mr. Armstrong was born in Perth, Scotland, in 1863. His parents came to this country when he was three years old, and settled in Chicago. In 1893 he and his brothers John, Hugh, and James founded the Armstrong Bros. Tool Co. at Chicago for the manufacture of machinists' tools. He is survived by his widow and six children. Three sons and four nephews will continue the active management of the concern.

COMING EVENTS

OCTOBER 1-5—Seventeenth Annual Safety Congress in New York City. Secretary of the New York Safety Committee, National Safety Council, Julien H. Harvey, 21 E. 40th St., New York City.

OCTOBER 8-12—Annual convention of the American Society for Steel Treating at Benjamin Franklin Hotel, Philadelphia, Pa. W. H. Eisenman, secretary, 7016 Euclid Ave., Cleveland, Ohio.

OCTOBER 8-12—Annual meeting of the Institute of Metals Division of the American Institute of Mining and Metallurgical Engineers at Benjamin Franklin Hotel, Philadelphia, Pa. W. M. Corse, secretary, 810-18th St., N.W., Washington, D. C.

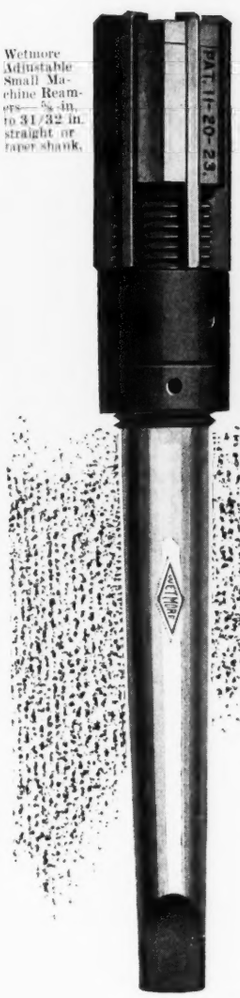
OCTOBER 8-12—Fall meeting of the American Welding Society at Bellevue-Stratford Hotel, Philadelphia, Pa. M.M. Kelley, secretary, 33 W. 39th St., New York City.

OCTOBER 8-12—Tenth National Metal Exposition held under the auspices of the American Society for Steel Treating at the Commercial Museum, Philadelphia, Pa. For further information, address W. H. Eisenman, National Secretary, 7016 Euclid Ave., Cleveland, Ohio.

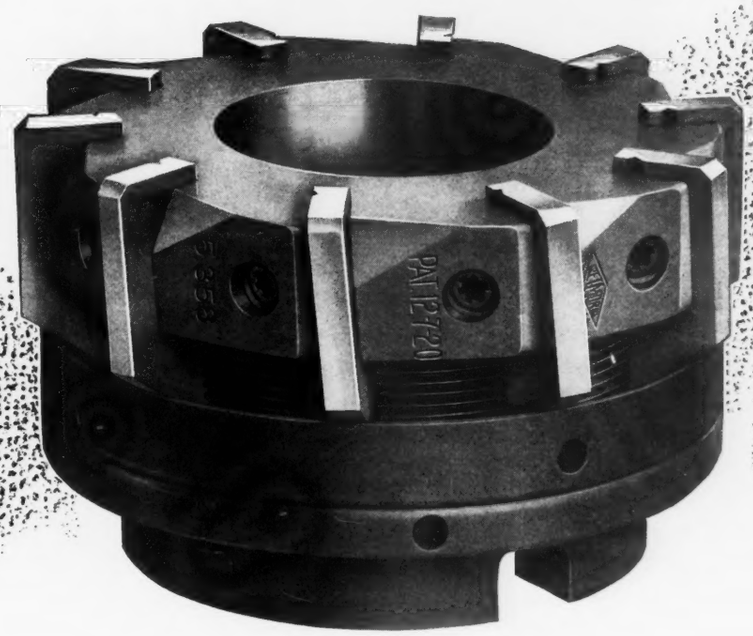
OCTOBER 11-13—Semi-annual meeting of the American Gear Manufacturers' Association at the Hotel Statler, Buffalo, N. Y. T. W. Owen, secretary, 3608 Euclid Ave., Cleveland, Ohio.

NOVEMBER 13-15—Convention of the American Management Association at Palmer House, Chicago, Ill. Secretary's address, 20 Vesey St., New York City.

5/8" to 12"



Wetmore Adjustable Small Machine Reamers—⅝ in. to 31/32 in. straight or taper shank.



Wetmore Adjustable Shell Reamer

—and any size in-between!

No matter how small or how large a reamer you need, get a ***Wetmore Adjustable Reamer.*** This famous reamer—now standard equipment in many of America's largest plants—ranges in size by thirty-seconds from ⅝ in. to 12 in. diameter. If the size you want isn't in stock, we will make it for you.

Here are four reasons why Wetmore Reamers cut production costs—do faster, more accurate work and stand up longer in service:

Adjustments to the thousandth of an inch can be made in less than a minute. In fact, the Wetmore is the quickest and easiest adjusting reamer made.

Solid, alloy steel body, heat-treated, guaranteed against breakage.

Left Hand Angle Cutting Blades that prevent digging in, chattering and scoring while backing out. Shearing effect of blades increases life of cutting edge.

No grinding arbor required for re-grinding. Wetmore Reamers can be re-ground on their original centers.

SEND NOW

—for Wetmore Catalog No. 26 of standard, heavy-duty, shell, small machine and cylinder reamers. Also arbors and replacement blades.

Let us prove these Wetmore advantages in your shop

WETMORE REAMER COMPANY
60 27th St., Milwaukee, Wis.

WETMORE ADJUSTABLE REAMERS

"THE BETTER REAMER"

NOVEMBER 22-23—Production meeting of the Society of Automotive Engineers at Hotel Book-Cadillac, Detroit, Mich. Chairman of Technical Program Committee, E. P. Blanchard, Bullard Machine Tool Co., Bridgeport, Conn.

DECEMBER 3-7—Annual meeting of the American Society of Mechanical Engineers to be held in the Engineering Societies Building, New York City. Calvin W. Rice, secretary, 29 W. 39th St., New York City.

DECEMBER 3-8—National Exposition of Power and Mechanical Engineering in the Grand Central Palace, New York City.

JANUARY 14-18, 1929—Western Metal Congress and Western States Metal and Machine Tool Exposition at Los Angeles, Cal., under the auspices of the American Society for Steel Treating; headquarters, Shrine Auditorium. Secretary, W. H. Eisenman, 7016 Euclid Ave., Cleveland, Ohio.

JANUARY 15-18—Annual meeting of the Society of Automotive Engineers at the Book-Cadillac Hotel. Detroit, Mich. Coker F. Clarkson, secretary, 29 W. 39th St., New York City.

APRIL 8-12—American Foundrymen's Association convention at Hotel Stevens, Chicago, Ill. Headquarters of association, 140 S. Dearborn St., Chicago, Ill.

NEW BOOKS AND PAMPHLETS

THE RELATION OF EDUCATION AND INCOME. 31 pages, 6 by 9 inches. Distributed by the Alpha Kappa Psi Fraternity, 1050 N. Delaware St., Indianapolis, Ind.

This little pamphlet contains a report of a study made during the past year by the Alpha Kappa Psi Fraternity under the direction of Dean Everett W. Lord of Boston University, on the relation between education and income. The report is based on the analysis of 7396 individual reports on occupational income and education, covering every occupation and every grade of education in all parts of the United States.

PRACTICAL INDUSTRIAL FURNACE DESIGN. By Matthew H. Mawhinney. 318 pages, 6 by 9 inches. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York City. Price, $4.

Conservation of fuel is a matter of great importance in modern civilization, and the author of this book believes that fuel can be conserved in industrial heating furnaces to a greater extent than it is at present by a better understanding of furnace operation. It is his purpose in this book to present practical information on operating principles and to clarify the factors that affect furnace operation. The book comprises a discussion of practical methods for the solution of the problems most frequently met in the selection, design, and operation of industrial heating furnaces, as distinguished from melting furnaces. The methods are based upon an accumulation of data, observations, and calculations. The text is divided into nine chapters, headed as follows: Introduction; Selection of Fuels; Application of Heat and Furnace Capacity; Methods of Material Handling; Fuel Consumption and Heat Saving; Refractory Design and Construction; Design of Metal Parts and Auxiliaries; Temperature Measurement and Furnace Control; and Practical Problems in Furnace Design.

NEW CATALOGUES AND CIRCULARS

WELDING EQUIPMENT. General Electric Co., Schenectady, N. Y. Bulletin GEA-556B, illustrating and describing GE automatic welding head and control.

NICKEL STEEL. International Nickel Co., Inc., 67 Wall St., New York City. Circular on the use of nickel steel in the Pratt & Whitney "Wasp" and "Hornet" aircraft engines.

HEATING EQUIPMENT. Ross Heater & Mfg. Co., Inc., Buffalo, N. Y. Catalogue containing data on Ross heaters for oil refineries, power plants, industrial plants, hotels, hospitals, office buildings, etc.

SPOT-WELDING MACHINES. Federal Machine & Welder Co., Dana Ave., Warren, Ohio. Bulletin 250, illustrating and describing Junior type spot welders and their application on typical classes of work.

CHAIN DRIVES. Diamond Chain & Mfg. Co., Indianapolis, Ind. Folder entitled "The Modern Timing Drive," announcing a timing drive that differs radically from those at present in general use on motor cars.

ELECTRIC SAFETY LIMIT STOPS. Electric Controller & Mfg. Co., Cleveland, Ohio. Circular descriptive of the application of Youngstown safety limit stops on cranes with either alternating—or direct-current motors.

MANGANESE STEEL. American Manganese Steel Co., 333 N. Michigan Ave., Chicago, Ill. Pocket-size pamphlet entitled "The Manganese Steel," outlining the history, advantages, and application of "Amsco" manganese steel.

GEAR SHAPERS. Fellows Gear Shaper Co., Springfield, Vt. Bulletin illustrating the application of the gear shaper for cutting spur, helical, and other gears for use in textile machines. The pamphlet illustrates typical work of this class.

ELECTRIC FITTINGS. Crouse-Hinds Co., Syracuse, N. Y. Bulletin 2119, containing data on new Obround condulets. Bulletin 2122, on types F and LB condulets that have been especially designed to facilitate the pulling of wires.

TURRET LATHE TOOLS. Jones & Lamson Machine Co., Springfield, Vt. Catalogue of tools for Jones & Lamson flat turret lathes, including standard tool outfits, both bar and chucking, as well as additional tools available for unusual jobs.

BORING AND MILLING MACHINES. Universal Boring Machine Co., Hudson, Mass. Bulletin illustrating and describing in detail the No. 24 "Tri-Way" boring and milling machine. Complete specifications of these machines are included.

RAILWAY EQUIPMENT. Walter A. Zelnicker Supply Co., St. Louis, Mo. Bulletin listing new and used railway equipment, including rails, cranes, shovels, cars, locomotives, boilers, steam engines, tanks, air compressors, machine tools, etc.

PULLEYS. W. A. Jones Foundry & Machine Co., 4409 W. Roosevelt Road, Chicago, Ill. Pulley catalogue featuring a new semi-steel molded pulley recently brought out by the company with a view to introducing a solid, strong, cast pulley.

MATERIAL HANDLING EQUIPMENT. Harrington Co., 17th and Callowhill Sts., Philadelphia, Pa. Catalogue O, illustrating and describing Harrington hand chain hoists,, electric hoists, trolleys, and traveling cranes. Parts lists and price lists are included.

STEAM POWER PLANT EQUIPMENT. Erie City Iron Works, Erie, Pa. Pamphlets illustrating and describing Erie City three-drum water-tube boiler; representative applications of this type of boiler in industrial plants; and Erie City "Unitype" pulverizers.

INSULATING MATERIALS. Campbell Fibre Co., Stanton, Del. Bulletin descriptive of the characteristics and uses of "Campbellite," a material suitable for punch stock for difficult fabricating, stock for insulating purposes, and panel stock for radio panels, etc.

MOTORS. Louis Allis Co., Milwaukee, Wis. Bulletin 507, illustrating and describing this company's line of direct-current motors, which are available both for general-purpose and special applications. The bulletin shows typical uses of these motors on various classes of work.

CAST IRON. Whiting Corporation, Harvey, Ill. Bulletin announcing a series of technical articles, which will be issued at approximately monthly intervals, on cast iron and its manufacture, prepared by Dr. Edward E. Marbaker of the Mellon Institute of Industrial Research.

HEAT-TREATING EQUIPMENT. Stanley P. Rockwell Co., 66 Trumbull St., Hartford, Conn. Bulletin 2808, entitled "Importance of Time Control in Heat-treatment Where Distortion is Detrimental," containing information relating to the use of the Rockwell "Dilatometer" for this service.

DRAFTING TABLES. Jerome W. Hurych Mfg. Co., 2431 Kindred St., Astoria, L. I. Circular descriptive of the automatic drafting table made by this concern. The illustrations show the table in the various positions in which it can be used, to enable a draftsman to do his work easily and quickly.

MILLING CUTTERS. Goddard & Goddard Co., Inc., Detroit, Mich. Booklet descriptive of a new line of "Go and Go" cutters, with taper dovetail inserted blades, developed primarily for heavy milling such as is done in locomotive shops. These tools, however, are also applicable for certain classes of lighter work.

ELECTRIC EQUIPMENT. General Electric Co., Schenectady, N. Y. Bulletins GEA-19E, 874B, and 1028, dealing, respectively, with alternating-current enclosed magnetic switches; portable type arc welder; and totally enclosed motors for use in explosive atmospheres. Price list of "Textolite" laminated and plastic molded products.

UNIVERSAL ROTARY SHEET METAL WORKING MACHINE. Peck, Stow & Wilcox Co., Southington, Conn. Circular descriptive of the "Pexto" universal combination rotary machine, with belted motor drive, for the small shop or sheet metal products maker, ventilating or heating contractor. The machine may be plugged into an ordinary lighting circuit.

SUPERHEATERS. Foster-Wheeler Corporation, 165 Broadway, New York City. Catalogue 304, containing a large number of illustrations of superheater installations A short history of Foster superheaters is given, as well as a description of their application to many types of boilers. A steam table, covering up to 1500 pounds absolute pressure and 300 degrees superheat, is included.

PIPE THREADING AND CUTTING MACHINES. Oster Mfg. Co., Cleveland, Ohio. Booklet entitled "Selling Pipe Machines Through the Ability to Meet Common Objections on the Part of the Prospect." The booklet is intended for the use of jobbers' salesmen, and will be sent free to any salesman who desires a copy regardless of whether or not the company he represents handles the Oster line.

DROP-FORGINGS. Interstate Drop Forge Co., 27th St. and Capitol Drive, Milwaukee, Wis. Bulletin entitled "Die-ology," covering the subject of drop-forgings and explaining modern die construction and board drop-hammer operation. It describes in non-technical language general operations. The subjects covered are the board drop-hammer, die-blocks, die-sinking and resinking, lock dies, lay-out, trimming and punching, draft, cleaning, restriking, and lead casts.

RECORDING AND INDICATING INSTRUMENTS. Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa. Catalogue 80, containing data on L & N resistance thermometers for controlling, recording, and indicating temperatures. The bulletin contains information on the selection of equipment of this kind; centralized temperature recording; and automatic recording at points of control. It also illustrates installations of L & N resistance thermometers, and gives complete price lists of the different types of equipment.

ARC-WELDING EQUIPMENT. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Manual for training arc-welding operators at the Westinghouse Welding School. The book is arranged in a sequence of instruction and practice. Following the basic theory of welding, simple exercises are explained, and gradually the more difficult exercises are taken up. The book should be of value to welding training schools, to manufacturers who are developing welding organizations, and to welders who are desirous of improving their skill.